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Proceedings

of the

New York Farmers

SEASON 1899-1900

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C. P. YOUNG, Stenographer.

The "New York Farmers"

HELD their first meeting of the season of 1899–1900 at the Metropolitan Club, on Tuesday, December 18, 1899, the President, Mr. Appleton, in the chair.

In opening the proceedings, the President said: Before we proceed to the discussion of the subject announced for this evening, we will pause a moment for some reflections upon the loss we have sustained through the death of our late member and friend, Mr. Cornelius Vanderbilt. I will call upon Mr. Beaman first to address us.

Mr. Beaman—Mr. President and New York Farmers: It has seemed to your President fitting, as it has seemed to me, that we should suspend our proceedings for a moment and record a word of reminiscence of our late fellow member, Mr. Vanderbilt.

Mr. Vanderbilt became one of us, New York Farmers, in 1886. During the early years of his membership he was frequently in attendance at our dinners, but latterly, as we all know, he has seldom been with us. His farm on Newport Island much interested him, and he was particularly fond of his herd of Jerseys there; but Mr. Vanderbilt was not a New York Farmer merely on that farm. He was a New York Farmer in the broader sense of the word here in New York City. Mr. Vanderbilt was born in 1843, and was born a farmer boy. His father, Mr. William H. Vanderbilt, was then, I think, 22 years old, and young Cornelius was brought up on his father's farm at New Dorp, Staten Island, and attended the country school there until he was 15 or 16 years of age. It was a few years later that he came to New York City, and from that time until his death he was substantially a New York Farmer. You are all New York Farmers. This is your own farm in New York, where you all work. It is a farm that is not large in acres simply, but is large in tillage land, large in pasture land, large in woodland; large in rainfall, large in droughts, and sometimes very large in expectations and crops, and then at times it produces a full crop of disappointments. Here Mr. Vanderbilt lived his life on this great New York farm. What kind of a farmer was Mr. Vanderbilt? He was preeminently a New York Farmer, as I look at him, not merely as an example, but as a

leader. It is not for me, gentlemen, who knew Mr. Vanderbilt much less than most of you, to speak of what kind of a man he was; but as I think of him, and as I knew him, he was to me preeminently the good New York Farmer; the good citizen farmer, the good citizen at home, and the good citizen away from home. But in that home life so sacred we have here no part. It was as a citizen and farmer of the City of New York in the largest sense, that we think of him and speak of him. In early life, his father having died, I think when he, Cornelius, was about 40 years of age, he became the head of this great New York Vanderbilt farm. What kind of a farmer was he? Those of you who knew him best and sat with him around many boards, knew what he was there as a President. Those of you who sat with him in other boards where he was not the presiding officer, knew with what faithfulness and strong sense of duty he there performed all his work. It was not simply in performing this work of President or Director, but in looking after the New York farm for all its owners, that Mr. Vanderbilt, as a man and a good citizen, looked after the New York farm; and for those who worked there for him as day laborers, and also for those for whom as stockholders Mr. Vanderbilt worked his farm, as it were, on shares, and every man who had an interest in or labored for that New York Vanderbilt farm had his full share of the crops. Every man who worked on that farm, even as a laborer, felt that at night Mr. Vanderbilt was seeing that in his little home or in the Young Men's Christian Association buildings or elsewhere, he was happy and was being looked after. Mr. Vanderbilt as a farmer on his big New York farm was preeminently a good citizen, and it was not only on this farm or his own, that he was a good citizen. But on this New York farm that is ours he was also a good citizen in all that concerned its welfare, in all that concerned its church life, in all that concerned its hospital life, in all that concerned its library life, and in all that concerned its college life. In what good work was he not a Trustee? Where was it that the products of his own farm were not used to benefit other poorer farmers? Mr. Vanderbilt as a citizen looking after this farm of his and of ours, was the good New York farmer. But, gentlemen, you can hardly speak of Mr. Vanderbilt as a New York farmer, without thinking of him as a farmer in a political sense. Mr. Vanderbilt was an earnest man, and as such he was a partisan. The duty, as I look at it, of every good farmer, of every good citizen, is to have political opinions and to have them earnestly. Not only did Mr. Vanderbilt have such opinions earnestly, but he had them fearlessly; he had them and knew that he had them and you knew that he had them. That is the kind of New York good citizen farmer that Mr. Vanderbilt was.

Some of you worked with Mr. Vanderbilt on the Committee of Seventy. Some New York farmers may then have been a little fearful that, with the great interests they had at stake, they could not fearlessly

say what they thought. But Mr. Vanderbilt not only then fearlessly said what he thought, but he contributed largely toward advancing what he thought. I never shall forget the occasion when, early in the evening of the day of Mayor Strong's election, I went to the Union League Club and there saw Mr. Vanderbilt throw his arms around one whom he knew but little, and hugging him say, "We have won! We have won!" His was the same enthusiasm which leads a college boy after a foot-ball victory to throw his hat in the air and his arms around his mates. In these affairs that concern our city, he was the earnest New York citizen.

You will not expect me to speak here at length in eulogy of Mr. Vanderbilt; but yet to you, his fellow farmers, it has seemed to Mr. Appleton and to me that it was appropriate that this word should be said in memory of the New York Farmer that Mr. Vanderbilt was.

His presence was always welcome. His absence will now be regretted, but the memory of Mr. Vanderbilt will long be a charm to us who remain.

Mr. Whitelaw Reid—Mr. President: It has been intimated that a word from me at this moment would not be unwelcome. I may frankly say I should not have volunteered it; but having had it suggested to me that I should speak, I would be profoundly sorry not to raise my voice in this presence in sad recollection of the man we have lost.

In the third of a century in which I have lived in New York I have known two men who seemed to me preeminently types of the model American citizen. The two men to whom I refer—and this is the point which occurred to me while Mr. Beaman was speaking, as being a most notable thing about Mr. Vanderbilt—were at that time probably the two wealthiest men on this continent. In spite of their wealth, perhaps—certainly not merely because of it—they were, in the judgment, I think, of all who knew them, and of all who passed any honest and fair judgment on their public acts, typical good citizens—good Americans, good friends, good neighbors, responsive to every just call, eager to do the right thing in every emergency, public or private, always to be depended upon. The one was John Jacob Astor and the other was Cornelius Vanderbilt. I have known no better men, none who more honestly and earnestly tried to do their full duty, in every position in which Providence placed them.

Consider for one moment at how many points Mr. Vanderbilt touched our common life. You knew him downtown as a business man, and you saw him eager in any moment of panic to come to the relief of the market, eager at any time when a friend was in distress to help him out if he could, eager always, in developing his own business, to aid as far as he could the general good.

But there was another side to Mr. Vanderbilt. You met him in the charitable associations; and how many there were to which he belonged. Who can here recount them? I happened to serve with him myself upon one or two boards, and surely there are gentlemen here who have

served with him on a dozen; and at every meeting of every board the first man to appear was apt to be Cornelius Vanderbilt, the man most precise and accurate in his knowledge of the business to be attended to, most careful as to every detail, most particular that the investments of that particular charity should be made in just the right securities, which would not only be safe, but would bring the largest income, and most anxious that the expenditures should be so regulated as to do the greatest good.

There was another side. He was a sincere Christian. No member of the congregation to which he belonged did so much for it, did it so unostentatiously, or took such pains to do it himself, rather than trust it to agents.

He was the head of a large family, all the members of which are men and women of influence in this community—influence proportioned to the great power that they control; and he was the representative before the world of the whole of that power. And there, I think, after all, is the best thing that Mr. Vanderbilt did. Representing this family of huge fortunes, he did his utmost to bring capital and labor together, and to make the men who worked for him regard him not merely as their employer but as their friend.

The Railroad Club which he established and which still exists, the many other manifestations of his interest in the working man, and his desire to promote the welfare of all the thousands of people employed directly or indirectly in the business which he controlled, have done more to resist the spread of communism than all the preaching and all the talking the rest of us have done. Example goes farther than precept, and Cornelius Vanderbilt set the best possible example to all the rest of us.

I venture to close these few words of unpremeditated but most sincere tribute by saying that I hope each one of us, who has in any degree command of such agencies as he controlled so largely, may use our talent in the same way in which he used his many talents, to avert the dangers which threaten our land, on the safe and only plan, by marrying the labor and the capital of the country.

The President—We will now proceed to the discussion of the topic which has been assigned for this evening, which is "The cultivation of small fruits." I am happy to say that some of the gentlemen who will address you have been with us before. We are always delighted to meet Mr. James Wood, of Mount Kisco, New York, who will be the first speaker.

Mr. James Wood—Mr. President and Gentlemen: Your Chairman has asked me to speak upon the general subject of the cultivation of small fruits. The first thing that comes to your mind and to mine as we approach this subject is, "What do you want to bother with this for, anyhow? You can buy all the small fruits you want, for just about half

what it will cost you to raise them. What do you want to bother yourself about this thing for, at all?" We might meet that with the question, "What do you want to bother yourself about your own horses and carriage for, since you can have your standing order at the livery stable for less than it would cost you to have your own? Why do you want to have your own house in the country? You can rent one for not one-half but one-quarter of what it costs you for your own house." And so we might go all along the line, and ask, "What do you want to have anything for of your own, so long as you can get the use of the other man's so much more economically." The fact that it is your own makes you want to have your own. No man should be allowed to own a place in the country who does not take an interest in the mere fact that it is his own. He should take a pleasure in these things because they are his own and not because he has raised them at a less expense, or at a greater expense, than he could have obtained them for in some other way.

Now, in regard to this subject which you have to consider this evening, according to my idea of a country gentleman—there should be a peculiar and an especial interest in the production of those things which his place can give to him and his household. And the production of small fruits is one of those interesting things. And it is not because they are so very valuable. You can get along without them altogether. You have doubtless, most of you, been in countries during the season of small fruits, when you have not had them and you have got along very well without them. Yet there is a pleasure, there is a luxury in having these things grown on your own place that counts very much in the sum of things that go to make up life, that go to determine the question whether life is worth living.

Strawberries grown in this latitude are much better than those grown in the South. Southern berries are deficient in quality, and as you journey further and further Northward you get them better and better, until you get your own; and better than your own are those grown still further North. It is a fact about which there can be no question that the quality of fruits that can be grown in any latitude improves as you go farther into the Northern regions. Whatever the fruit, there is a quality that is developed in the North that the South never can give; and that is especially true of small fruits. Those of you who have eaten strawberries grown in Canada have eaten better fruit than you ever ate grown in a Southern or Middle State. Those of you who have eaten strawberries on the other side of the Atlantic have found the highest flavor and best quality in those grown in Scotland; and, if you went to the extreme north of Scotland, you found them better than they were in the South. I do not hesitate to say that the best strawberries I have ever eaten were produced just on the borders of the Arctic Circle, in Norway. The strawberries of Denmark are better than those grown anywhere on the continent of Europe further south.

You want to make your own season last just as long as possible. I shall not encroach upon the subject that has been assigned to my friend, Mr. Withers, who will speak to you, as I am informed, upon the growing of small fruits under glass; but possibly Mr. Withers will not refer to a subject to which I have given some attention, and that is the lengthening of the strawberry season by growing the earliest berries in cold frames—not by forcing with artificial heat, but in that simplest of all things, the cold frame.

You who have country places, if you have given attention to the subject, are well aware that of all the artificial things on your place, that which gives you most and costs you least is the cold frame.

I will not talk about varieties, because there are five hundred new varieties every year, on the average. The man is crazy who undertakes to keep pace with them. You can read the reports of the experiment stations and all that sort of thing, and when you have finished reading them you will know as much as you did when you began. There are some varieties of strawberries that will do best on a clay soil, and some on a light soil. Some of the finest varieties of strawberries in the world can only be grown on clay, and some of the finest varieties can only be grown on sandy soil. There is a bottom fact for you to consider. Some of the finest varieties, like the Marshall, beautiful to the eye and delightful to the palate, and the Gandy, which prolongs the season by its lateness, can only be grown at their best upon clay soils. It becomes a question then, where upon our place have we clay? Perhaps it is all clay. If so, you are all right as to these particular varieties. If not, look over your place to find where you have the clay. It may be that you have what you are looking for, particularly if your farms are in this region lying east of the Hudson River, and going out into New England, up and down what is known by geologists as the Taconic formation. One of the peculiarities of that formation is that you have in the way of soils about everything in the new world. You will probably find on your place some soil that has clay. And here you run up against an old English idea about a garden. You cannot have things in perfection if you have the idea of growing your vegetables and your fruit in *a* garden. The English idea is to have a wall around an enclosure, and have beds and grow things in this one enclosure. It cannot be done to perfection. You want to find on your estate *the* spot that is suited to *this* and the spot that is suited to *that* and the spot that is suited to the other thing, and there grow them.

I have only instanced the Marshall and the Gandy to illustrate a general principle that you must find the conditions suited to the plant which you wish to grow. Now, the same general law applies in the vegetable kingdom as in the animal kingdom. We are the result of two forces, one the force of heredity that comes down from ancestry, and the other the force of environment; and these two things go to make up every animal and every plant of which you and I know anything. You

have to consult the forces of heredity and environment in the breeding of animals and the growing of plants. The same principle runs through them all. Suppose you find that you have no clay soil on your place. What are you going to do about it? Get it elsewhere, and put it upon your ground. There is nothing very difficult about this. I have seen it done over and over again. Probably some of you have done it. If you want a clay loam, and you haven't it on your place, make it. Haul the clay one mile or five miles, and add it in the right proportions, and put it on in the Winter, at this season of the year, where it will freeze, and you can grow just as fine fruit as they can where they have the clay to begin with; and the same with the sand. If your soil is a clay loam, and you want some varieties that can only be grown on a sandy loam, haul in the sand. When you figure out the cost of a quart of berries, they may be a little expensive. We have to overcome the obstacles that are in our way; and that is one of the greatest pleasures in life. What I have said about strawberries, applies to raspberries and blackberries, although they are not so sensitive to the conditions under which they grow as are strawberries.

Mr. Appleton has asked me to speak in a practical way of the general subject of cultivation. The old English idea to which I have referred is to have a garden and beds of things; to have a strawberry bed; to have a bed of this and a bed of that and a bed of the other thing. Well, where a man has only the sixteenth of an acre, of course he has to have things in beds; but to a gentleman who has plenty of land to use as he pleases, better results can be obtained than by growing in beds. Everything will grow better in rows, I care not what that thing may be—your vegetables, your fruits, whatever you grow. You can cultivate a row by horse-power or by other means. You can get a better result from a row than you can ever get from a bed, without the most extravagant expenditure of labor on that bed. The highest possible result in the cultivation of the strawberry is obtained by growing in hills. That is, you put down a plant, and do not allow that plant to send out any runners. Of course, you all know that the strawberry reproduces itself by runners. That is, it makes a growth of a runner, with a bud on the end of it, and that develops a root, which takes hold of the ground and makes a plant. Of course, the strawberry, like all other vegetation, reproduces its kind from seeds. The highest result is obtained by pinching off all the runners, then the individual plant will develop vigorously, and the dormant buds on every side will grow until it has grown into a great plant; and then with proper cultivation you will obtain finer fruit than can be obtained from any other treatment of the plant.

Next to that comes the cultivation in rows by which you confine the runners to a narrow space lengthwise with the row. Put the plants out in the Spring; allow the runners to grow; cultivate frequently; and where the runners become too thick and matted, cut them out until you have your

row a foot wide in space, and not too thick so as to be crowded. Let them grow throughout the season; cultivate and develop these plants to their greatest possible luxuriance; and at this season of the year, not too early, cover them with stable litter that is largely composed of straw with not too much manure. Protect your plants from freezing and thawing. A great many gardeners protect plants in the Autumn. Nothing on the lawn or in the garden should be protected in the Autumn. A December freeze rarely kills anything. It is the February and March freeze that kills things. Everything is better to have its December. You are better, your children are better, every plant on your place is better to have a December. December is a part of the law of nature. But when you have gone through your Winter there comes the freezing and thawing of Spring, and that is a trying time for the plants and for you. You want to go South in March. February and March cut you, and sap the vigor of your life. December braces you up. So it is with plants. I have seen on many a gentleman's country place quantities of plants ruined, because, when frost began to come in November, the gardener started to "straw up" and protect things, so preventing them from having that which every one of us requires (without which our children do not become strong men and women), a December in the year. Do not let your gardeners protect anything until this season of the year—about the latter part of December or the first of January.

When the ground is settled in the Spring and the weeds begin to grow, put in your cultivators between the rows, and cultivate the ground as thoroughly as possible. Understand, your mulch is still all upon your strawberries, keeping them back and preventing them from blooming too early. If they bloom too early an untimely frost may blight the bloom, and you would be disappointed in the result. We will presume your soil is already well fertilized. Nitrogen is the element that nature requires for the development of a plant. It is an element which nature also requires for the development of your children. We will suppose, then, that that is already done. In the Spring time you want to do that which will make fruit, and fruit of the highest quality. You do not want any more growth. The nitrogen was supplied the season before to promote the growth of the plant. But when the Spring time comes, and the strawberry blossoms, you want it to develop the highest quality and greatest quantity of fruit. You have an assured quantity by the vigorous growth of your plants in the previous season. That insures quantity, other things being favorable. Now, what you want is quality. It is found by long experience that the three foods which nature requires for all plants are nitrogen, phosphoric acid and potash. Nitrogen furnishes the growth and development of the plant; potash gives the quality to the fruit, so you add potash in the form of wood ashes, if you have them. If not, buy the ashes and put them upon your soil.

After you have cultivated as thoroughly and deeply as you can to

make the soil light and loose, draw the litter that you have had for a mulch over your strawberries off to these spaces between the rows, and haul in other coarse litter, covering the space between your rows as thoroughly and completely as you can with a heavy mulch, and you have done all there is to do.

The President—How often must that be done ?

Mr. Wood—Every year. Never attempt to get a second crop of strawberries from a planting. The man who undertakes to get a second crop of strawberries simply bids for trouble and failure.

The President—What do you suggest as the proper time to plant?

Mr. Wood—Plant in the Spring. Grow them the first year and reap your harvest the second year; and just so soon as the strawberry season is over, plow up the ground. You should have started another plantation in the Spring somewhere else; and so the thing goes on.

So much on the general question of cultivation. There is one other thing I wish to ask your attention to, and gentlemen who own country places have neglected it more than any other important thing; and that is, irrigation. It is indispensable, to always obtain the best results. In this country we have occasionally in June a very severe drought. During this past year we had such a one. It was very hot and it did not rain for weeks, and all our vegetable and fruit plantations suffered severely in consequence. Every one of us should have an irrigation plant upon his place, to irrigate the vegetables and fruits of every kind. It matters not whether it be the strawberry, raspberry or blackberry, they all suffer alike from drought in the Summer. Occasionally in July there comes such a drought that, while you get a few raspberries in the beginning of the season, they then dry up and produce nothing but bunches of seed. You may have the finest of blackberry plantations in May, but occasionally there comes a drought and your blackberry bushes produce similar bunches of seed. Now, irrigation is particularly desirable for the strawberry. I have never seen anywhere, in any country, the results of irrigation so marked as in Mexico. At Irapuato they have ripe strawberries every day in the year. Those of you who have stopped at Irapuato could have bought strawberries on the railway platform, it matters not whether it was in January, February, March, April or May—or December. Now, how can they have strawberries on every day in the year? It is simply the result of irrigation. The rainfall on that high plateau of Mexico is comparatively small, enough to grow some crops, but not enough to make vigorous growth of such a plant as the strawberry. The range of temperature there is the smallest of any part of the inhabited world. That is, there is less difference between January and July on the table land of Mexico than anywhere else. Having the temperature thus favorable, what do they do? A man has a quarter of an acre here and another quarter of an acre there, and so on down the line. The plants are dormant, they are so dry. He begins to irrigate so as to

have them come on and develop their fruit in January, in one section, and the next to come on in February, and the next in March, and so on throughout the year. And irrigation there is a serious business, because they hoist all their water from deep wells. What they do there you can in a measure do here. Our range of temperature is so great that you cannot have strawberries every day in the year, but we can do a great deal with the aid of irrigation. In the first place, we can gather not only a crop every year, but a crop of the highest excellence, and we can lengthen the season very greatly by the use of irrigation. For instance, I spoke to you about the Gandy strawberries. If you have a very dry season you can bring on the Gandys two weeks later by deferring your irrigation. Some of the earliest varieties you can bring on a week or ten days earlier, if you wish. It would be interesting for you to give attention to this matter. It is profitable for the commercial grower. The only commercial growers that I know of anywhere in this country who have given attention to this matter are Walter Taber & Son, of Poughkeepsie. They have an irrigation plant. They are purely commercial growers, and it pays them to do this for the market; and if it pays the commercial grower to do it for the market, how much more will it pay you to produce such results?

Mr. Burden—I would like to ask Mr. Wood about the cultivation of strawberries. To what extent do you fertilize them before you plant?

Mr. Wood—For the growing of any small fruit you want a thoroughly cultivated and pulverized soil. Fertilization is a comparative matter. You want enough plant food in your soil to make a vigorous growth. Some soils have that plant food without the addition of any more. Some soils require more or less added to it. You must be the judge of that. But remember that you must have a well-fertilized soil, and that that soil must be thoroughly pulverized, for strawberries or raspberries or any of the small fruits.

Gentlemen, I am going to ask you to allow me to say one word about the gooseberry. Those of you who have been in England in the gooseberry season know that it is the favorite fruit of that country. Although the gooseberry grows well here—it used to grow well on the Island of Manhattan, it is grown in Westchester County and all through New England—yet the fine varieties of gooseberries we have not cultivated in this country until very recently, because of the trouble with mildew. In the south of England they grow the finest gooseberries by growing them in the shade. They are grown in the gardens of the laboring people. One of the charms of travel in England is to go about in the rural districts and see the cottages with their roses and their gooseberries. While in the south of England they get the finest results from growing gooseberries in the shade, in the north of England they grow them in the sunshine. Just bring that idea over here. With our sunshine we can grow some of the best English varieties. With shade,

with irrigation to furnish the moisture, and with spraying to prevent the attacks from moisture, we can grow as fine gooseberries, or approximately as fine, as they grow in England. Gooseberry culture is worthy your best attention.

Mr. Burden—You spoke of the use of wood ashes. You would not apply wood ashes to clay soil?

Mr. Wood—Oh, yes. Clay soil needs potash as well as any other soil. No injury can possibly result, but only benefit.

The President—I shall now have the pleasure of introducing to you Mr. James W. Withers, who will speak particularly upon the cultivation of small fruits under glass. Mr. Withers is the editor of a horticultural paper published in this city, called "American Gardening."

Mr. James W. Withers—Mr. President and Gentlemen: When I received the invitation of your President to be here to-night, I was assigned to speak upon the subject of small fruits. The subject was entirely too large, so I went up and saw Mr. Appleton, and told him that we could not get through in one week, and that I did not make a specialty of field culture, but devoted more of my time to getting things out of season—what is sometimes called fancy gardening or greenhouse work. I remember some three or four years ago one of your members, Mr. Samuel Thorne, told me if I could put him in the way of getting strawberries for Christmas time, especially for Christmas Day, he would feel exceedingly obliged. I told Mr. Thorne at that time that I could not do it, but since then we have been making a little progress. While strawberries have been produced for Christmas Day in England for possibly the last thirty years, and in this country for the last twenty years, it is not generally known how it can be done. So I thought perhaps I had better confine myself to a few moments of talk about producing things out of season, and that was the suggestion I made to your President, to which he agreed. Of course, small fruits are grown under glass only in a small way as compared with Pomona. A gentleman wanted to know one day if he could not get raspberries under glass. I told him no. He could not see why. Well, there are some things that will be amenable to such treatment, but there are others that will not be, and the raspberry and the blackberry will not come into line so that you can get them out of season under glass. The peach, the grape, the plum, the pear, the apple can be got. You can do just as you like with these. You can do practically anything you like with the strawberry. It takes money, it takes time, it takes patience, it takes skill; and I believe all of those the New York Farmers have—or they can buy them.

I am not such a gifted speaker as the gentleman who has just preceded me, so you will have to pardon my use of notes. I am more accustomed to answering questions than I am to public speaking, and I shall be prepared to answer any questions that may arise when I am through with this paper.

HOW TO HAVE STRAWBERRIES THE YEAR ROUND.

This title will at first, no doubt, raise an incredulous smile to those present, or anyone else, perhaps, in the vicinity of New York. Yet it is no joke, neither need it be left to the imagination. It is a plain, practical possibility. That this, the richest and most luscious of all the group known as small fruits, can be had on the table every day in the year, providing one is ready to pay the price for the fancy. The two most difficult months in the year to indulge will be September and October, but even then it is not impossible.

The question then is, how can it be done and how are we to have them?—remembering that only up to a very short time ago Christmas to July was the limit. The answer is, improvement and selection of varieties, improved methods of forcing and a wider area of supply of natural or out-door grown berries. For instance, California, thanks to the improved methods of transportation, supplies the New York market in November and December; of course, the quality is not all that could be desired; still, they are strawberries. Then, beginning with Christmas Day, our own nearby skilled gardeners begin to furnish us with perfect quality from the hot-house. Of course, these come expensive, as every full-sized berry grown in that manner and bought from the retail dealer at that season costs from 50 cents to $1.00 each, or from $9.00 to $12.00 per quart. And please do not run away with the idea that there is a fortune to the grower in it at those figures; there is not; for they are costly to provide and yield but a small profit to the producer. As the season advances he makes more money when he wholesales at $3.00 per quart.

In February, Antonia, Florida, begins to send berries to this market and they get here in fair condition. In March the supply of greenhouse or nearby grown berries is more abundant and you can indulge more freely, for you can then get the best at $3.00 to $4.00 per quart, and Floridas at $1.00.

In April the market is supplied from the same sources.

In May we get them in cold frames in this latitude, and when Florida drops out, Georgia begins, then Maryland and Delaware, next South Jersey, next Monmouth County in that State, closely followed by Long Island and other spots around the metropolis; then up river, then up State (New York;) and that formerly ended the season, but now it is prolonged hereabouts by the use of several imported kinds that bear the title of everbearing. St. Joseph is evidently the standby among these and has proven itself capable of producing luscious berries in August and September; and next October I have not the slightest doubt that I shall pick first quality fruit. That completes the year's supply and proves that strawberries every month in the year in New York City is no fancy. It has been done and will continue to be done as long as anyone is rich enough and willing to pay the price; and, it being

the privilege of the wealthy to eat such luxuries, that this interesting fad will be encouraged there is no doubt.

The next question that arises is how is it to be done, or what are the methods adopted to produce them successfully in the hot-house or cold frame?

Leaving, then, the natural or out-door contributions from the West and the South, I will confine myself to the forcing exclusively. First comes a selection of varieties. It is important that it be what is known as perfect, or capable of self-pollenization. This is requisite to obtain a good set of fruit. My selection would be Jessie, Belmont, Marshall, Royal Sovereign, Jersey Queen and Sharpless. These have all been properly tested and have proven themselves to be good forcers. The best three of these would be Belmont, Marshall and Royal Sovereign. The last named is a variety imported from England within the last five years. The other two are standard American sorts.

RAISING THE PLANTS.

The orthodox English style, which is frequently adopted here, is to plant early runners in June over small pots and let them root in these, or else to peg the same down and then, when rooted, pot them. In these early stages only ordinary soil may be used, but later and when put into the fruiting pots a very rich compost is used, heavy feeding being the rule at all times when the plant is in active growth, up to the time the fruit begins to color. The strawberry is a liberal feeder, so that, in addition to the rich compost (and, by the way, the soil needs to be kept lumpy and the loam as retentive and fibrous as possible), liquid cow manure water can be used liberally. Other foods that the strawberry indulges in are bone, potash, phosphoric acid and nitrate of soda. But these, owing to their powerful stimulation, are better left out unless they are applied by the student for experiment, or by an experienced grower, as the formula for an acre of ground is 1600 pounds to the acre, consisting of seven per cent. potash, seven per cent. phosphoric acid and one per cent. nitrate of soda, this last being applied only as a stimulant to start good leaf growth. The orthodox style is to get early runners potted up as soon as possible, first into small pots, then removed, when ready, into six and seven inch pots, the earth in this last shift being packed very tightly with a wooden rammer. The pots are stood on ashes or slates to keep cool and prevent worms from getting into the soil. Watering is an important part, the plants when active never being allowed to get dust dry. Then, in the Fall, the plants are permitted to rest or ripen. The pots are placed on their sides and no water applied. The roots are better for being frozen slightly; not enough, though, for the pots to crack with the frost. After this ripening and freezing, forcing may begin; so the plants are introduced in batches to the forcing house and given a temperature of from 55 degrees to 65 degrees. The

pots are placed where the plants will get the very best light and be near the glass. This method will always produce excellent fruit during February and March. But the Christmas and January fruit have to be treated differently in order to guarantee success. What follows now is entirely new in this country, it never before having been published. I will be able now to do for our friend, Mr. Thorne, what I could not do three or four years ago. We have been working quietly and silently meantime, so that the information has scarcely reached the press, but I can now let him into the secret.

In order to guarantee success special houses are needed and they must be given up exclusively to the plant. The method adopted by commercial growers who make this a business is to build houses similar to a regular rose house and plant out on benches of a similar depth. The plants are prepared for these houses in out-door frames. Runners are started in early Spring in these, and instead of being in pots are planted out and encouraged to make the largest possible crowns. They are carefully watched and all successive runners cut away. Then in August the first batch is transplanted into the fruiting bench indoors and brought into active growth again. In this way fruit is obtained by Christmas Day.

Two evils that have to be guarded against when so treated are mildew and red spider, and here the patience and skill of the trained gardener is taxed to the utmost and only skilled men can be expected to produce good results. Amateurs and unskilled growers had better confine themselves to getting early fruit in the greenhouse and later in cold frames, for by both of these systems fairly good results can be obtained by lifting strong fruiting crowns from the out-door patch and potting the same or transplanting them into frames. It requires but little skill or expense to get August and September fruit from the St. Joseph. The only secret of that is, that the variety is so extremely fruitful that it insists on fruiting from all the new runners it makes. Consequently early runners can be potted and fruited the same season.

As I have previously said, you could do your best and your gardeners could only give you strawberries in February. They could give you good fruit in February, better in March, and better still in April; but this method of furnishing strawberries on Christmas Day they have not found out. Of course, the men are not to be blamed, because of the need of special houses and special treatment; but they have not "got-on-to" the wrinkle of planting the runners in frames very early in the season and thus encouraging a big, strong fruiting crown. Without that, you cannot get good fruit under glass and be forced with a temperature of 60 degrees. The pot has generally failed to give you the crown, so that, say in 100, you only get 45 fruiting pots. At the very best you would only get 75. But with this system of putting the runner in a frame in the early Spring and encouraging great growth there, you can

in August lift that plant and put it in your greenhouse bench, as you do your carnation and rose, and get your strawberries on Christmas Day. And better still, you can get a succession right along from your frame by transplanting the frames to the house all through the months up to the Spring. The cold frame, as friend Wood has described, is possible to everybody, whether they have or have not either a greenhouse or a skilled gardener. It is possible to everyone who has six feet of ground, because he can put his strawberry in it and let it remain there, and get choice, full-flavored, perfect fruit, according to his treatment of the frame, from two weeks to a month ahead of fruit from out-doors. This greenhouse fruit is of course a little weak, compared with the full-flavored fruit to be gathered out of doors in June. Still, they are strawberries of good color and size. They must be of good size, when about thirteen fruit from our best growers will fill a quart. Do not blame your gardeners, because they do not have all the facilities; but if you give them the small house or bench, they can do it. There is one thing that must always be remembered about getting these things out of season—that it takes a skilled man to do it. The common garden laborer is not equal to it. He never was and he never will be equal to it.

I have mentioned two evils that have to be fought in forcing strawberries. The first is mildew and the second is the red spider. If your gardener gets his temperature too high, he gets mildew. If he gets too much moisture he gets mildew. If he omits the moisture, which the plants need, he gets red spider. You must find the man who knows how to strike the happy medium and avoid both these evils, because they are what he will have to fight against all the time he is forcing the strawberry under glass.

Last year was the first year the St. Joseph became generally known in this country. It has a decided Alpine flavor, which to many is agreeable. It is not quite so large as our ordinary garden strawberry, but there is no question about its fruitfulness. It fruits from the runners, so that the first runners it makes in the early part of the season will bear fruit the first season; and that can be done twice. You can take the first runners in pots and fruit them, and the next runners it makes will fruit in the open garden during August and September; and in some cases during last October, while we were not able to pick perfect fruit, we had plenty of blossoms, which goes to prove that it will fruit out-doors in October—of course, with protection. So that we can say that by using the frame there is no question that St. Josephs will fruit all the Fall.

The President—I now have the pleasure of calling upon our old friend, who has addressed us before, always entertainingly and instructively, Mr. H. W. Collingwood, of "The Rural New-Yorker."

Mr. H. W. Collingwood, of "The Rural New-Yorker," addressed the Farmers as follows:

I want to speak a word for my little friend in scarlet, the strawberry.

I call it the king of small fruits; so does my friend, the Alaskan Indian, only he has an original way of eating it. While I prefer cream and sugar as a dressing, the Alaskan wants it served in fish oil. This is a free country, and while the analysis of the cream and sugar is about the same as that of the fish oil, it becomes a matter of every man to his taste. You all doubtless know the old story of how the devil first tasted shad, and considered it such a delicacy that, with his usual perversity, he filled it full of bones as he was opposed to having man enjoy any heavenly essence without difficulty. He later tasted the strawberry, and ever since that day it has been a source of perpetual remorse with him that he used all the bones on the shad.

I wish to talk of some of the odd things connected with strawberry growing, in order to make the discussion come out even. The chief object of its culture is to produce the finest possible flavored fruit, and then to prolong its season through as many days as possible. The American people always want to saw off a poor thing and pull out a good one. I have seen farmers who were almost unable to pay their dog tax, save up their pennies to buy early southern-grown strawberries, which were five days old on the peddler's wagon.

Strawberries grow wild. Some farmers' wives know that to their sorrow, when they wear out fifteen cents worth of shoe leather in order to find ten cents worth of fruit. Birds carry the seeds off into the woods and the plants themselves run off into solitude when fields go out of cultivation. This wild fruit is usually of exquisite flavor, but too small for practical value. In order to do its best the plant must be bred and fed with care and skill. My own plan is to grow the plants themselves in the lightest and most open soil I can find. After their root growth has been well developed, I put the plants in the richest soil I can find, and then feed them heavily.

Why is this? Possibly I can make my meaning clearer by comparing the work of the human plant. If I wanted a man to grasp and direct great industrial or financial forces in the city, I should want him bred and fed in the country on the farm. It would be better, I think, to have him reared in what we may call respectable poverty. That would harden his muscles, sharpen his mind, and put powerful strength into his desires. He would come to the town with a solution of the old farm rock in his blood, dissolved out by hard sweat. His desires and ambitions would be sharpened and tempered by hard conditions and strong character. When placed among the richer opportunities of the town, he would reach out and grasp them with a stronger and longer reach than if he had known them from boyhood. It might be said, if this is true, why not go still further and secure a digger Indian, or a wild strawberry plant. The trouble with the digger Indian would be that he knows nothing but digging. He has no ambitions beyond the satisfaction of animal desires, and these would be too easily satisfied in the city. The

wild plants are mostly seedlings, or have a dozen generations of loafers behind them. The loafing habit must be bred out of a man or a strawberry plant, or they will steal if only given a chance. Like horses, cows, or men, strawberries must have certain fixed habits before they are worth cultivating. To the credit of the strawberry it must be said, that a runner is always a chip of the old block. If given a fair chance, they will exactly duplicate the good works of their parents, while it is unfortunately true that with human runners, there are usually nine splinters to one chip.

I want my plants started in poverty and fed in rich soil, because the open soil induces a better growth of root. The strawberry deals in watered stock. A quart of this fruit contains over 90 per cent. of water, while milk averages about 87 per cent. During the growing season, the average strawberry plant probably pumps up through its roots, and sends off through its leaves, nearly half a barrel of water. The roots of a plant represent its mouth or stomach, while the leaves represent its lungs. It is just as easy for a man to keep in good healthy condition by washing his hands in beef tea as to expect a plant to absorb moisture or food through its leaves. I have heard of a man who discovered a new system of irrigation. He planted onions among his potatoes, and it is said that the onions caused the eyes of the potatoes to weep so that they irrigated both crops. I question, however, if this has ever been scientifically demonstrated.

The root system of the strawberry is naturally restricted. We cannot coax its roots out as with some other plants. If you will bury a bone in the ground six feet away from a grape vine or raspberry bush, you will find that the roots actually turn in the soil and work straight for the bone. You will find them at the end of the growing season turned in that direction, etching their record upon the surface of the bone. The strawberry root does not do this because it seems incapable of doing so. It is not its nature and you cannot coax it into making an extended root growth. When I was a boy, the minister's horse, an amiable beast, was sometimes turned out into the road to pick up grass by the wayside. Some of the bad boys have been known to fasten a stick along the neck of this interesting animal with a bunch of tender clover dangling in the air just about one foot in advance of his nose. He could not possibly reach it, but he could reach for it, and I have known the poor thing to travel several miles away from home in a vain effort to reach that clover. I rejoice to say that my friend, the strawberry, has more sense than that, and you cannot make its roots travel away from home on any such wild-goose chase. No, the strawberry must work in a peck measure. The roots go down rather than out into the road. I can take an ordinary tin can and push it down around a strawberry plant of good size, and when I pull it up, I will have 75 per cent. of the roots. Such crops as corn, potatoes, grapes or raspberries, will run out

and cover the entire surface of the ground, but the strawberry roots rarely go one foot out away from the plant. I have known strawberry plants to produce about as great a weight of fruit as a large raspberry bush. While the roots of the raspberry run all through a space equal in size to an ordinary room, the strawberry does most of its work inside of one cubic foot of soil. Thus we see that the strawberry demands soluble food, which must be brought close up to it.

A calf and a baby may be fed from the same cow, but the calf can chase the cow all over a ten-acre field, and get its supper on the run, while the milk must be put in a bottle and brought up to within a few inches of the baby's mouth, before it can be fed. This illustrates the difference in feeding a raspberry and a strawberry plant, for the strawberry is more like the baby, and demands soluble food close at hand. This also explains why the strawberry responds so quickly to irrigation. When applied just at the right time, the roots are really force pumps which are made larger and larger in the loose open soil. By actual experiment, I have found that a large strawberry plant, in time of drought, requires just about as much water every day as a good-sized man.

Another thing we must remember about the strawberry is that the fruit for next season is already made. It is all over but the sprouting. The buds which later on will grow into flower and fruit are already formed, with the food stored up in the crown of the plant. Very much as in the case of asparagus, the material for the fruit is made during the late Fall and early Winter, and stored up for Spring use in the crown of the plant. Now, there is nothing worth having that jumps immediately into existence. I cannot put a spelling book under my little girl's pillow and have her wake up in the morning with a perfect knowledge of English. I will not guarantee that the carrying of a copy of "The Rural New-Yorker" in his hat, will change a farmer into an agriculturist. We find, unhappily, that the mere raising of the starry flag in Cuba does not make a star-spangled-banner patriot out of every Cuban. All these things require time and long growth, and our little friend, the strawberry, does not do it all in the Spring. It simply pumps up the water and packs it into the fruit, but the pump itself was made beforehand, and you cannot tinker it up and build a new pump in the Spring. That this is true, has been demonstrated by taking strawberry plants before they started in the Spring and transplanting them into coal ashes, where absolutely nothing but water was supplied them. They were not fed in the usual sense of the word, and yet they produced a fair crop of fruit. Thus we see why I want my strawberry plants to grow in rich soil, so that they may make the best possible growth during the Summer and Fall, when these fruit buds or plant pumps are made and put together.

Sometimes we find the soil too rich; that is, there is too much nitrogen in it, and while the plant makes a fine strong growth of leaf and

vine, there are but few fruit buds. Appearances are often deceitful, and sometimes a tremendous growth of vine in this way proves a great disappointment. I knew a man once who had an original standard for judging a man's character. He looked for what he called "the Lord's ear-marks" on a man's knees. That meant, that whenever a man showed dust on his knees, it indicated that he had been down on his knees in prayer. This man received a terrible shock one day, on finding a man with his knees covered with dust, who had been literally crawling on the floor to find a 25-cent piece which the old gentleman had lost. It won't always do to look at a large, rank growth of vine, and assume that it is sure to produce plenty of fruit. I have found that stable manure alone is apt to grow more leaf than fruit, because it is rich in nitrogen. Potash and phosphoric acid are absolutely necessary. Potash is thought to influence the color and flavor of the fruit. The sulphate of potash is the best form for quality. Too much nitrogen affects the fruit of the strawberry about as an excess of flattery affects the average human—it makes a soft head. Where extra fine fruit is desired, I have found it best to set the plants singly in hills or in narrow matted rows. As is well known, the strawberry is propagated by runners which start out from the crown, and throw down roots which fix themselves in the ground and form new plants. I have known well-fed plants to set 40 of these runners in a single season, though the varieties differ greatly in this respect. For heavy fruiting, I think three young plants from the parent are enough. I would cut the other runners off. It is thought that the buds packed away in the stem which produce fruit or new plants are interchangeable. That is, when we destroy the power of the bud to root its runners, it may turn to the production of a stem or spray of fruit. If a man will shut off his bad habits persistently, he will probably find them changed to good works.

It is one thing to produce good fruit and another thing to prolong the season. In New Jersey we pick strawberries every day in the year. We pick them from the plant about 35 days, and from the pantry shelves in cans for about 330 days. This year, in New York City, there were only a few days in July and August when fresh strawberries could not be bought. We started with hothouse fruit, with Floridas, following the States North along the cost until late in July, running as far North as the upper part of Quebec Province. The latter part of August and September fruit began to come from the Pacific coast, and is now to be had every day in the week. Hothouses are said to be later than usual this year, but it is probable that with an ordinary season there are hardly ten days out of the 365 that one cannot buy fruit fresh from the vine. Scientific men are trying to find some method of prolonging the crop from the home garden. Plant breeding is extensively carried on. Different varieties are crossed in the hope of obtaining some variety earlier or later than those in cultivation. My friend, Dr. Halsted, even talks

in a playful way of crossing the strawberry and the milkweed, so as to grow strawberries and cream on the same vine. The result of this production of new varieties is that from Michael's Early to Gandy we have about 35 days of fruit. Like life, however, this season is too short, and practical men ask if there is not some way of holding the plants back from their natural fruiting. With most things, I think, restraint is better than stimulation. A chain beats a whip. When the warm weather of Spring starts up the grass, the natural tendency of the strawberry plant is to do its duty. This cannot be said of any man except, possibly, poets. The strawberry must be kept at a low temperature and away from the sun, or it will surely produce fruit. One method has been to put on a very heavy mulching of straw or cow manure while the ground is frozen solid, and keep the mulch on until the plants grow up through it. This will often hold them back for ten days, though in some cases they grow so rapidly when they do start, that they will nearly catch up with the others. In some cases, the plants have been dug in the Fall, with a large bowl of earth, and put into cold storage, held close to the freezing point. In this way they are held dormant until late in the Spring, and then set out and well cared for. This has usually given a small late crop, but for some reason the transplanted plant will not do its best until it gets a firm grip on the soil. Most experiments have been with cold, but a few growers go to the other extreme and use heat. The plants are grown in the ordinary way. Just as the first blooms open, dry straw is scattered along the rows, and when the wind is right, set on fire. The whole thing is thus burned off—straw, plants and all. The entire Spring growth is burned down to the ground. Then, if it is possible to do so, water is applied to the plants, with possibly a little nitrate of soda. A new growth soon starts, and, if the plants were strong and vigorous enough to begin with, they will produce a new and late crop of fruit. If this burning is done too late, the plants will not respond, nor will they put out a second crop of fruit unless there is food enough stored up in the crown of the plant from the previous year's growth. This shows again the necessity of forcing the plants hard during its working life, which is one season ahead of its fruit.

The most remarkable experiment, however, in starting strawberries is that conducted by Mr. S. R. Divine, of Sullivan County, N. Y. Mr. Divine has a large pond near his strawberry field. He tried keeping individual plants in cold storage, and then transplanting them, but this was not a success. He then decided to ice them just where they were growing in the field. He took one-quarter of an acre of handsome plants, and as soon as the ground was frozen, covered them with about two inches of stalks of straw. On January 22d, when the ground was covered with a foot of snow, he hauled a layer of ice, 16 inches thick, and put it right on top of the snow, all over the field. On February 5th, a second layer of ice, 14 inches thick, was put on over the first, and

later 7½ tons of buckwheat straw was scattered on top of the ice. Thus, there were in addition to the snow, 2½ feet of ice, and 10 inches of straw on top of the strawberry plants. It required 680 tons of ice to cover the quarter of an acre. My little friend, the strawberry, is cold-blooded, and thoroughly enjoyed this overcoat. By the middle of April, it was found that the frost had left the ground, but the ice remained on the field up to June 23d, when a few small pieces were to be found. At that time the last of the straw was taken off, and put between the plants. Then the plants began to grow in a wonderful manner. The first ripe fruit was picked on July 16th. On August 18th they were still picking, and for two weeks later, or nearly to the 1st of September, small pickings of fruit were obtained. By fruiting some of the earlier varieties at their natural season and uncovering part of the iced plants at various times, a constant supply of fresh fruit was obtained for 90 days. Thus the plants were kept asleep, and when they finally woke up they proceeded to business, fully rested after their long nap. Mr. Divine estimated that these strawberries cost 22 cents per quart, calculating the ice at its average selling price. Nearly 1,000 quarts of beautiful strawberries were produced on the quarter of an acre. They came at a time when there was absolutely no competition and sold readily at 40 cents a quart. Mr. Divine thinks that if he had put another layer of ice on the field, he could have retarded the fruit a month later.

It will be noticed that as the ice melted, the water soaked into the soil and kept it thoroughly moist around the plants, so that when they did wake up the conditions were just exactly ripe for their work. We all know how, with average culture, the fruiting season frequently comes in a time of drought, and after forcing our plants to produce a large number of fruit buds, we find them unable to develop their fruit because of a lack of moisture. Late varieties, like Marshall, Gandy or Brandywine, would be best for this experiment, and if one has plenty of ice, there seems no doubt but that this scheme can be used on at least a part of the strawberry patch.

After a vote of thanks to the gentlemen who had addressed them, and to the steward of the evening, the Farmers adjourned to meet on Tuesday, January 16, 1900.

The

"New York Farmers"

HELD their second meeting of the season of 1899–1900 at the Club House of the Metropolitan Club, on Tuesday, January 16, 1900, the President, Mr. Daniel F. Appleton, in the chair.

In opening the proceedings, Mr. Appleton said: Fellow Farmers: The subject for discussion this evening, "Electricity and its effects on the growth of plants," is one in which we are all interested. We are fortunate in having with us several gentlemen who have paid much attention to the subject, both practically and scientifically, and they are prepared to instruct and entertain us by detailing what they have learned and what they expect to achieve. The larger subject has been subdivided into several branches, the first of which will be considered by Dr. John A. Myers, of New York City, formerly the Director of the Experiment Station in West Virginia. He will explain the effect of electricity applied directly to the soil and the plant itself; also the experiments in attempting to secure nitrogen out of the air by means of electrical discharge. I now have the pleasure of introducing Dr. Myers.

Dr. John A. Myers then delivered the following address:

Gentlemen of the New York Farmers' Club—The subject which has been assigned for discussion this evening is "The application of electricity to the growth of plants."

A survey of the field of knowledge bearing upon this subject at once impresses us with the fact that electricity may have extensive application to the operations of agriculture. I do not understand that your Committee contemplated the discussion of the problems of electrical and mechanical engineering connected with the application of electricity to farm machinery, as this division of the subject would naturally fall within the domain of knowledge outside of that claimed by any of the speakers whom you have invited to address you this evening. I shall therefore consider that branch of the subject as being eliminated from the discussion. The subject will then naturally be compassed within two general heads:

(1) The indirect effect of electricity upon plant growth.

(2) And the direct effect of electricity in its various forms upon plant growth.

Under the first head, we consider the effect of electricity in providing supplies of plant food, such as nitrates and ammonia in the air or in the soil, upon which the plant feeds and develops a vigorous and rapid growth. This was discussed two years ago, to a considerable extent, by Sir William Crookes, the President of the British Association for the Advancement of Science, who laid special stress upon the fact that the wheat crops of the world may possibly soon become inadequate to meet the demands of our rapidly increasing population, and that scientific men must, in the near future, provide some means by which the enormous stores of nitrogen, representing four-fifths of the entire bulk of the atmosphere, may, in a measure, be converted into available plant food, for supplying the demands of future generations for food. For this purpose, he suggests the utilization of the energy now going to waste in great waterfalls like Niagara. His idea is to convert the latent and unavailable plant food of the atmosphere into available combinations, by the action of electricity, and utilize this product in manuring the extensive grain fields of the world. In short, he proposes to convert the nitrogen of the air into nitrates, which are the most powerful fertilizers known, and use them for the production of grain. This proposition, if carried out, would make electricity the most important force—next to the energy of the sun—in providing food supplies for the thronging millions of earth's future populations.

Other scientists have considered the possibility of the impending disaster foretold by Prof. Crookes as being of trivial importance, in view of the wonderful supplies of plant food which nature has stored up in reserve, and which it is continually developing. It must not be forgotten, however, that the electricity of the atmosphere is an important factor in the production of available plant food, in the form of nitrates, which are carried into the soil and absorbed by the plant.

The existence of nitrates in the air was first proven by Leibig. The presence of ammonia in the atmosphere was first noticed by de Saussure. The effect of atmospheric electricity upon plant growth was studied by Grandeau, of France, in 1878. He showed that the maize plant, grown in the open air, where it was subject to normal electrical conditions, was superior in every way to that grown in a wire cage, so constructed as to deprive the plants of their atmospheric electricity; the yield of the plants outside of the cage being from 50 per cent. to 75 per cent. more than the plants within. [See Plate I.] The chemical composition of the plants growing inside of the cage was also disturbed. It is not improbable that the change in composition, etc., of the maize plant, noticed by Grandeau, was due to a failure of the plants within the cage to secure the usual supplies of nitrates provided in the air by electrical activity. The plants may have suffered from inadequate plant food provided by this agency.

Fisher, of Waldheim, tried the effect of atmospheric electricity col-

lected by accumulators placed upon insulated metallic standards, erected at regular intervals around an area of land and conducting the electricity into or over the soil, as a lightning rod does when placed over a building. Sixty of these posts were arranged around a plat of approximately two and one-half acres in extent, and he claimed that the yield of cereals upon this area was nearly one-half greater than upon an adjoining plat of equal size. [See Plate II.]

In 1885, Dr. Selém Lemström, of the University of Helsingfors, Finland, studied the effect of a highly electrified atmosphere upon plant growth, by stringing parallel wires, about a yard apart, across a plat of ground. These wires were attached to insulated posts, and had metallic points at intervals of about twenty inches, which could discharge electricity into the air, thus enabling him to keep the air over the plat thoroughly charged with electricity. [See Plate III.] The wires were connected with a Holz electrical machine, and currents supplied from 6 to 10 o'clock A. M. and from 5 to 9 o'clock, P. M., from the middle of June to the first of September, during their growing period.

Mr. Twombly—How near the plant was that put?

Prof. Myers—If I remember correctly, about twenty-two inches above; but I am not positive about it.

Mr. Barnes—What was the plant?

Prof. Myers—He worked on a variety of plants.

Mr. Sturgis—Can you name any of them?

Prof. Myers—Barley was one.

The portion of the field over which the wires extended gave yield of 35 per cent. more barley, of better quality, than that produced upon the unwired, equal portion of the field. He also experimented in like manner upon white beets, red beets, potatoes, leeks, celeriac, turnips and rutabagas, which gave increased yields, varying from 107 per cent. to 1 per cent. in the order named, over the yields of corresponding areas of unwired plats. He repeated his experiments at Paris in 1888, with similar results, from which he concluded that "the effect of electricity will be the same in all parts of the globe." It was also shown that the more favorable the external conditions the more marked were the effects of electricity; also that plants arrange themselves into two groups—those benefited and those injured by the electricity. He thinks that there are chemical changes brought about in the atmosphere by the electric current, whereby the growth of plants is profoundly and usually beneficially affected. The first object of his experiments was to determine whether the exceedingly rapid growth of Arctic vegetation was influenced by the highly electrified condition of the atmosphere in those regions; and his work seems to indicate this to be a fact.

It is probable that the galvanic currents of electricity are continually moving through the soil and have important influence in effecting liberations of various plant foods in the soil. As evidence of this, we

have experiments conducted by Sheppard, of England, and Foster, of Scotland, in 1846, in which copper and zinc plates were introduced into the soil and connected by wires to facilitate the passage of the currents of electricity within the soil. Sheppard found that the grass near the electrodes was killed, but that root crops were increased and improved by the treatment. [See Plate IV.]

Mr. Twombly—How much power did he put through the wire?

Prof. Myers—It is the current generated by a powerful Holz machine. I do not know that there is any particular measure of it.

In 1847, Hubeck, of Germany, enclosed a field in a net of wires, so arranged as to facilitate the passage of electrical currents under the soil, and claimed it resulted in early germination of all kinds of seeds, and a larger yield of buckwheat. About the same time, experiments which were conducted by Fife, in England, and Von Ende, in Germany, gave negative results, and the latter recommended that further attempts at growing plants by electricity be abandoned. Some years later, Fichter placed parallel wires underground, and connected them with a battery. Between the wires he placed peas, barley and grass, and the resultant crop increased from 15 to 30 per cent. above results upon the check plats. [See Plate V.] The battery was placed off on the outside, and is not shown here.

Mr. Sturgis—Were the wires in the soil?

Prof. Myers—The wires were in the soil.

This brings us to the experimental work along the line, begun at the Massachusetts Experiment Station in 1893. I have learned long since not to poach on the preserves of a Yankee, and Prof. Brooks, of the Massachusetts Agricultural College, is here, and will doubtless be prepared to discuss the work that was carried on at that institution. I will drop this branch of the subject at this point, with the remark that some of the most careful and interesting scientific work that has been done anywhere in the world, upon the effect of currents of electricity upon plant growth, has been done at the Massachusetts Experiment Station.

I will go back now and take up another branch of the subject. It was noticed, perhaps over 150 years ago, by Mambray, that myrtle trees subjected to the influence of electricity had their flowering periods considerably hastened. These observations were substantiated by the physicists Jollabert and Nollet, and botanists agreed that plants respond in varying degrees to the strength and frequency of the application of electric stimulus. Abbé Nollet tried the effect of the electric current upon the germinating capacity of seeds, and his results indicated that germination is hastened by the action of electrical currents. Specnew treated moist beans, peas, barley, and sunflower seeds with electricity, by enclosing them in cylinders between metallic disks, and passing a current from an induction coil through the disks. The seeds were

treated two or three minutes in this way, and then planted. [See Plate VI.] He used for this purpose Ruhmkorff coil, which was attached to these wires, the sparks of electricity being passed through these moist seeds. In every case the seeds which were treated sprouted in about half the time required by the untreated seeds. Pauline found that the sprouting capacity of old seeds was increased by treating with electricity in a similar manner.

This brings us again to the point where the Massachusetts Experiment Station has taken up the work and continued it with great care.

If it is a fact, as has apparently been demonstrated, that electric currents affect not only the germination of seeds but also the growth of plants, what, if any, is the electrical condition of portions of the plants above and below the ground? It is evident to every scientific man that the movement of electric currents in the soil must produce a difference of electric potential in the organs of the plant beneath the ground, and probably also above the ground. Upon this question there is an abundance of literature, to which time will not permit me to refer in detail: but I may summarize it by saying that it has been found, by Buff, that the exterior sub-aerial parts of the plant are in a state of permanent positive electrification, whereas the roots and the internal tissue of the plant are electrically negative. Delicate galvanometers indicate the movement of an electric current from the root, through the plant, to the surface of the stem and leaf above the ground. Not only this, but there are constant currents of electricity moving upon the leaves or through the leaves of the plant. Every leaf has a series of local currents moving through and upon it. Munk, in studying the leaf of Dionaea Muscipula (Venus fly-trap) found that the mid rib is electrically positive to all points of the lamina on either surface. He has measured with great care the movements of the electric currents in different directions over the leaf, both on the upper (ventral) and lower (dorsal) sides. The movement of electric currents in the plant have been determined with almost as much care as Du Bois-Reymond has determined the movement of the electric currents in the muscle and nerve of the animal system. The action of electric currents upon the plant, according to Burdon-Sanderson, produces phenomena similar to those exhibited by nerves (electrotonus) under similar conditions.

Kunkel ascertained by a number of experiments of different kinds that whenever a current of water is set up between one part of a plant organ and another, it is accompanied by a disturbance of the electric equilibrium. Buff considers these currents to be quite independent of the vital process of the plant, and in this opinion he is supported by Jurgensen, Heidenhain and Ranke.

Elfving found that when a current runs through the long axis of the root, its growth is retarded, and more markedly when the direction of the current is opposed to that of the growth of the length of the root.

He found that the passage of electric currents through growing organs, when a root is placed in a vertical position between two electrodes, is usually to curve the roots toward the positive electrode—that is, against the direction of the current—and that the majority of roots are negatively galvanotropic—that is, curve toward the positive electrode. [See Plate VII.] This explains the curious phenomena observed by many farmers, that the roots of a plant—take a stock of corn, for example—turn towards a mass of plant food, such, for example, as a bone buried in the soil, off to one side. It also explains the penetrating power of roots to enter a tile or box containing moist plant food. Perhaps every one has noticed how a tree will fill a drain tile or culvert with fine roots, if available plant food is contained within, or is carried through the tile or culvert.

The number of experiments bearing upon the explanation of the *internal and external electric conditions of the plant* are so numerous and so complicated that I will not weary your patience by discussing them longer. They involve more of technical knowledge of a special scientific character than would be interesting upon this occasion.

This closes what I have to say in regard to the direct effect of electricity upon plant growth by means of electrical currents passing through or round the plants. The next branch of the subject which I take up is "the effect of electricity, when converted into light, upon plant growth."

This divides itself naturally into two heads:

(1) The effect of the arc-electric light upon vegetation.

(2) The effect of the incandescent light upon vegetation.

The finest and perhaps most extensive work that has ever been done under the first heading of this subject, was conducted by my friend, Prof. Bailey, of Cornell University. Prof. Bailey is as polished and as bright as a new door knob, and, if you will excuse the expression, I am not permitted to play on his front steps. I will therefore consider the effect of the incandescent light upon vegetation.

Extensive experiments in this branch of the subject were conducted under me while Director of the West Virginia Agricultural Experiment Station, by Prof. F. W. Rane, now of the New Hampshire Agricultural College. The report was published in a bulletin of the West Virginia Agricultural Experiment Station, which has been largely circulated in this country and abroad. The investigation was intended to be supplemental to the work upon the effect of the arc-light, that had been and was then under way by Prof. Bailey, of Cornell, and Siemans, of England. It was thought then that the electric light might become an important factor in forcing greenhouse vegetation for the early markets, but, as difficulties had been encountered by Prof. Bailey, we hoped to overcome these difficulties by means of the incandescent light. It is easy to secure incandescent lamps furnishing a candle power of from 16 to 500, and by combining these lamps into groups it was possible to get

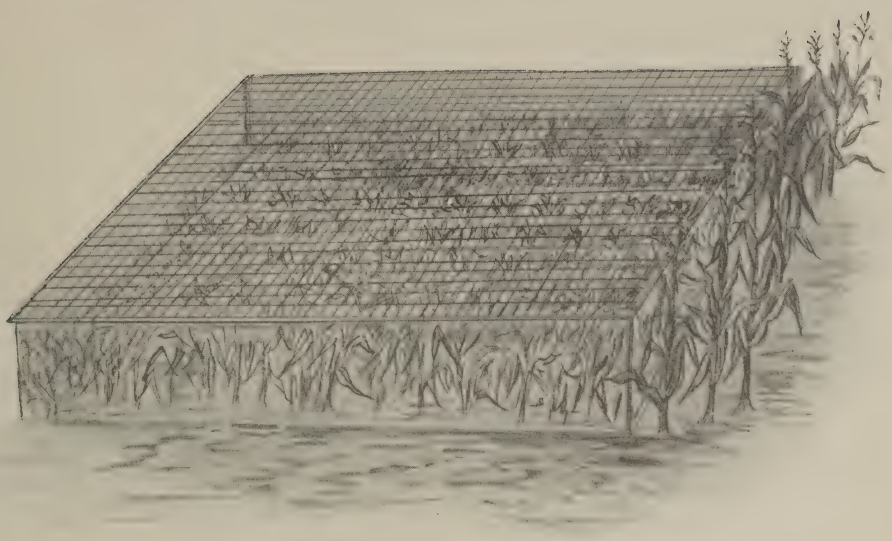

PLATE I

PLATE II

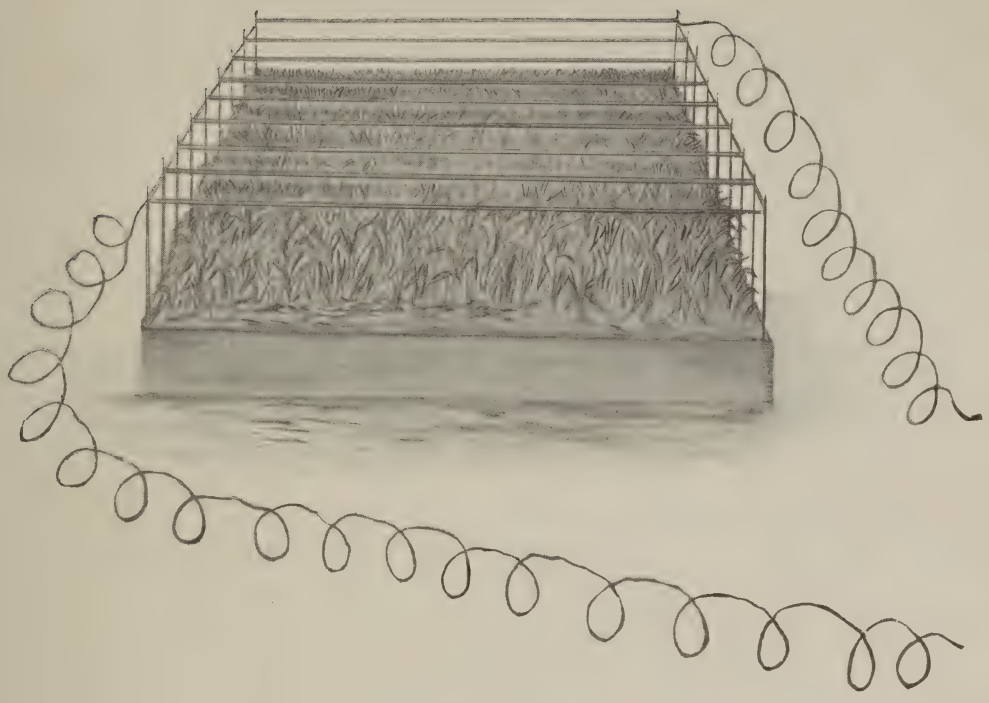

PLATE III

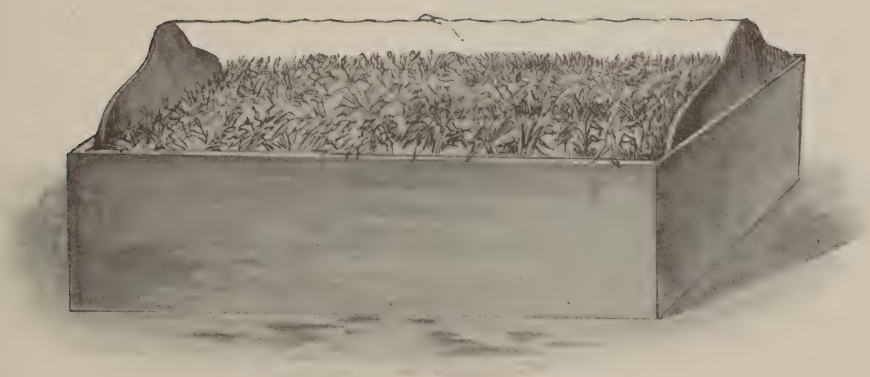

PLATE IV

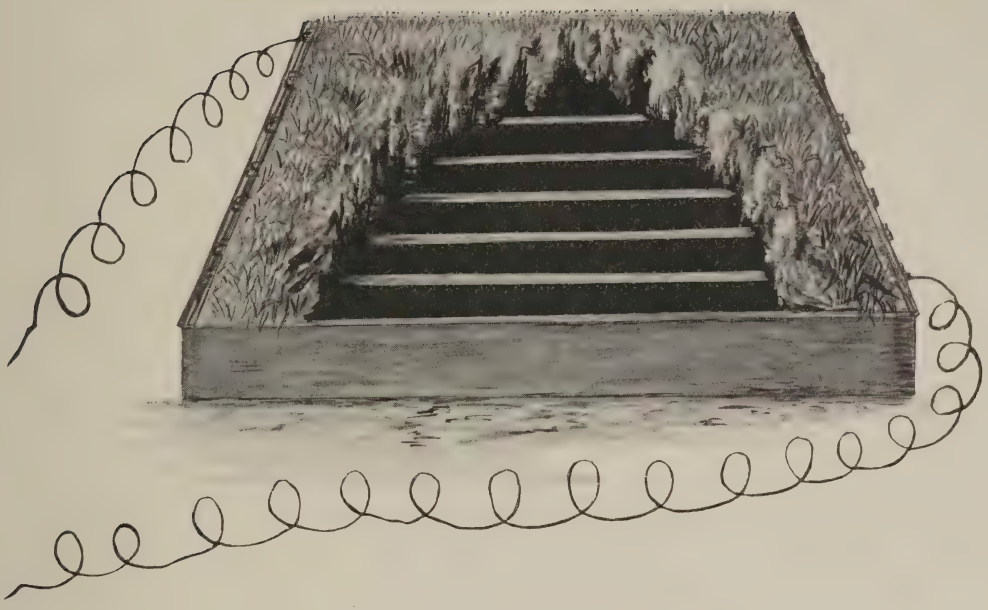

PLATE V

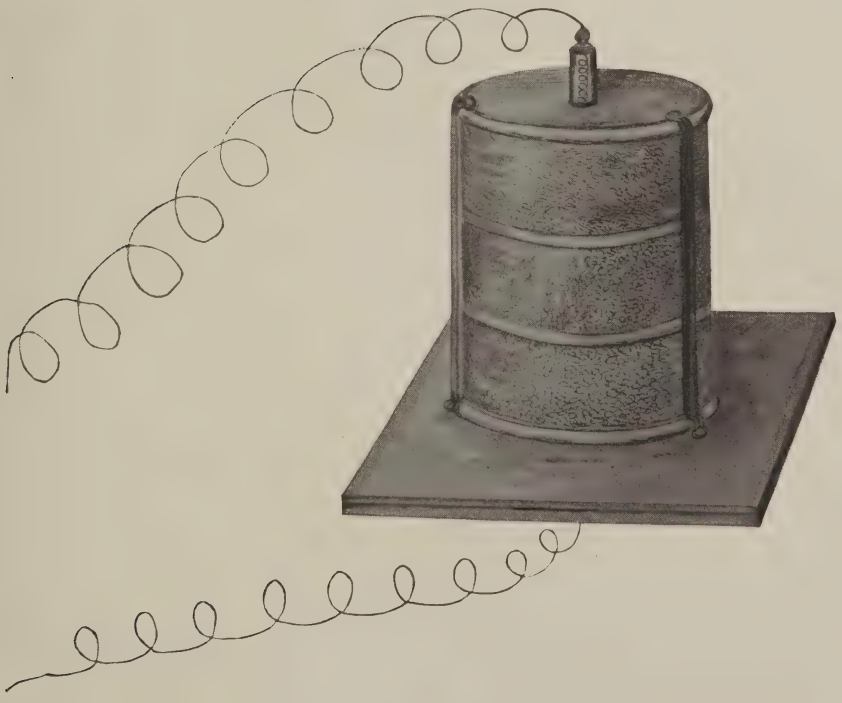

PLATE VI

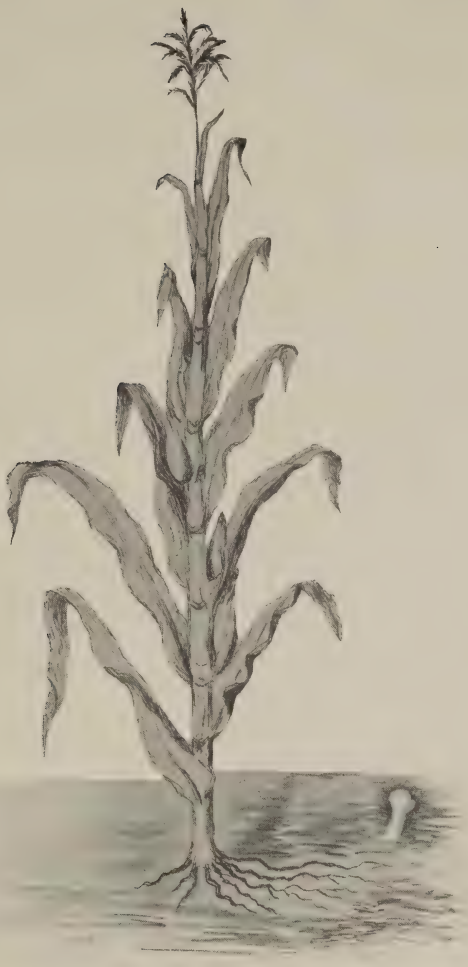

PLATE VII

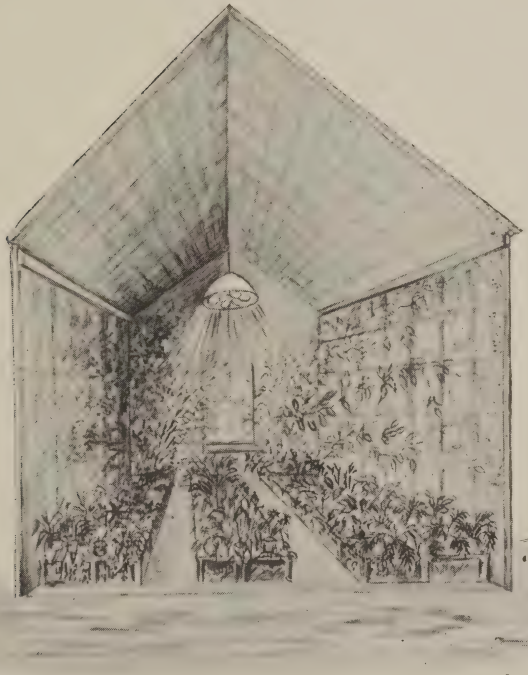

PLATE VIII

16, 32, 48 candle power, up to any number of candle power that we wished. I believe we confined our experiments to grouping the lamps so as to produce 112 candle power, and from that down. The experiments were conducted in a properly constructed greenhouse, provided with modern conveniences, and extended over part of two years, covering several series of experiments with the different crops. [See Plate VIII.] The results of these experiments were stated by Prof. Rane as follows:

First.—The incandescent electric light has a marked effect upon greenhouse plants.

Second.—The incandesent electric light appears to be beneficial to some plants grown for foliage, such as lettuce. It was earlier, weighed more, and stood more erect.

Third.—Flowering plants bloomed earlier and continued longer in bloom under the light.

Fourth.—The electric light influences some plants, such as spinach and endive, to run to seed quickly, which is objectionable in forcing these for sale.

Fifth.—The proper watering seems to be more important with radishes, beans and cuttings, than improper water plus the electric light.

Sixth.—The stronger the candle power, the more marked the results, other conditions being the same.

Seventh.—Most plants tend to a taller growth under the light.

Eighth.—It is doubtful whether the incandescent light can be used in the greenhouse from an economic standpoint on other plants than lettuce and perhaps flowering plants, and, at present prices, it is a question if it will pay to employ it even for this.

Ninth.—There are many points about incandescent light that appear to make it preferable to arc light for greenhouse use.

Tenth.—Although we have not yet established the economy and practicability of the electric light upon plant growth, still I am convinced that there is a future for it.

In the latter conclusion, personally, I scarcely agree with Prof. Rane, although I agree to the expression "a future for it," as an indefinite term of undetermined value.

In conclusion, I have attempted, in the time at my disposal, to call your attention to the effect of electricity in providing supplies of plant food with which to nourish vegetation and increase our crops, this being produced by atmospheric electricity, and possibly by the movement of electric currents through the earth. I have drawn your attention to a number of most important experiments conducted in this country and abroad, showing the effect of electricity when acting directly or indi rectly upon plant life. You have had your attention called to the electrical condition of plants both above and beneath the soil, and the effect of electric currents in turning the roots of the plant toward supplies of food, and I have given you the results of a considerable series of experi-

ments, conducted under my supervision, upon the effects of the incandescent light upon vegetation. From my standpoint the electric light, as a rule, has not proved profitable as a means of forcing early crops, and the general effect may in some cases be better accomplished by the skillful use of Nitrate of Soda as a fertilizer, than by the use of the electric light as a stimulant to plant growth.

Mr. Appleton—I have now the pleasure of introducing a gentleman of whom the last speaker has spoken, Professor L. H. Bailey, Professor of Horticulture at Cornell University. He will speak upon the branch of the subject as to the effect of electric light on the growth of plants.

Prof. Bailey said—Mr. President and Gentlemen: My first interest in the influence of electricity on plants was aroused some ten years ago, at which time I was engaged in problems of electrocution. It occurred to me that possibly we could get rid of the insects on plants by electrifying the plants, and in that way kill them or make them get off. I had in my mind's eye a picture of all our greenhouses with all of the benches insulated, and myself coming in and touching a button and the bugs dropping off. It was necessary to make experiments before we began, and I recall very well those we made on cauliflower and cabbage, plants which were grown in a house, and on which had been colonized the worms which are so fond of those plants in the open. They were placed on pieces of rubber, and into the ground was put one pole of a battery, the other pole touching the plants, and electric currents were then applied to the plants to compel the bugs to leave. I was very much interested in watching the antics of those bugs. It was a novel sensation to the bug as he felt the lightning creeping up his spinal column and going off in sparks from his ears. He was ordinarily very much disturbed, and sometimes killed, when he was on the nerves of the leaf, or on some harder portions of the plant; but whenever he was on the soft tissues, which are comparatively non-conductors, he was entirely unconcerned. I found that after electricity had been applied to these plants for some time, the insects seemed to know the safe places, and they simply walked on to the non-electrified part of the leaf. Thereafter I applied the currents to the extent of killing the plants themselves, but the insects were still alive and vigorous. I was consequently obliged to give up the idea of knocking the insects off the plants by means of electric currents.

When we approach the subject of electricity and its relation to plant growth, we may divide it up into three heads:

First.—The effect on the plant itself, as a direct stimulus to it.

Second.—The electrification of the atmosphere, by which we make new chemical combinations in the air.

Third.—We have the whole subject of electric lighting, which is not electricity at all.

What is the arc light? Simply the spectrum of carbon plus that of

some of the gases which are given off as products of combustion. In other words, the spectrum which we use in the arc light is not peculiar to the electrical discharge, but is the spectrum of the burning substances which are given off from the poles of our arc light. The subject is not one of electricity, but entirely of illumination. Electricity is only the means of giving us this illumination. Of course the subject of the application of electric lighting to plants is new, because the electric light itself is new; but the subject of electric currents applied to plants is old, as Dr. Meyers has told you.

You will see by the prints which I am having passed around the table, some figures which were made over a hundred years ago, showing the ideas of those times as to the application of electricity to farming. One is the application of a current of electricity to the atmosphere directly over the plants, so that an electric current is set up through the plant and the soil. Another idea is the application of electricity as power. It was proposed, about the year 1780, to have a cart drawn back and forth through the field, so that the farmer could stand on the cart and water his plants. You can see these ideas represented in the two pictures now being passed.

The most important experiments of which I know with reference to the electrification of the atmosphere are those which have been mentioned by Dr. Meyers, by Prof. Lemström in Finland. I have the honor to be acquainted with Prof. Lemström and have followed his experiments with much interest, and I may say that we are now contemplating arrangements at Cornell whereby, in this coming season, we are to experiment on a somewhat large scale on the electrification of the atmosphere. I shall therefore say nothing further on those subjects, but will give you some general points or hints in regard to our own work with the electric light.

We began this work in 1890 and have continued it for six consecutive years. It is the largest experiment on the influence of the electric light on plants which has been conducted. I may say, however, prefatory to these remarks, that many experiments had been made, running back for a period of twenty or thirty or forty years, as to the influence of the electric light upon the physiology of plants. That is to say, experiments in the laboratory have been made with the view to determine whether or not plants would assimilate under the electric light; but none were made in a practical way until Siemans made experiments in the late seventies. The experiments showed that various plants could be very much hastened by the influence of the electric light. A Frenchman (Dehérain) also showed that assimilation could proceed under the influence of electric light as under sunlight. It was shown, in other words, that the electric light is competent to piece out the sunlight. The experiment showed, however, that the electric light is not a substitute for sunlight. In other words growing plants by the sun

during the day and by electric light at night is feasible. Growing plants only by electric light is not feasible. Some plants will die almost immediately, some will live for a short time, while some will come to maturity, but yield very moderately.

Our first experiments were with a naked arc light; that is, one which had no glass covering it. This was run all night. We conceived the idea that, where seasons were exceedingly cloudy, if we could piece out the normal day time by electric light we would gain very much. We found that every plant with which we experimented, with the exception of carrots, was greatly injured; but carrots were neither injured nor benefited. Carrots standing four months under the direct influence of the electric light, and sometimes only six or seven feet away, seemed to respond in no way to the influence of the illumination. Now, it happened that in this series of experiments certain plants were in the shade of posts in the greenhouse. They were gas pipe posts, an inch and a half in diameter, and wherever those posts interposed and a heavy shadow was cast the plants were better, and where the shadows were still larger the plants were still better; but in every case the plants were injured. How? Because they ran to maturity with exceeding quickness. That is, after becoming established in the soil, in three or four weeks they would tend to go to seed, making few leaves. It was evident, therefore, that there was some very markedly injurious effect produced by the electric light, and that there was something there besides illumination—because those plants which were in the shade received reflected light; they were not in total darkness. The plants in the shadow were better than those grown in a neighboring house, which had no light at night and had the light of day, so that it looked as if there was some influence, besides the illumination, in the electric spectrum which was injurious to those plants. I shall not detail all the results of those experiments, but will only say that the great results shown were three: that the plants were injured; that they were made to hasten their maturity; that there seemed to be something outside of mere illumination which injured them.

The second winter we began a new series of experiments, by running an electric light all night, but screening the light with a bit of second or third quality window glass. We had accidently discovered, in some experiments during the winter before, that an ordinary transparent pane of glass very much reduced the injury. We found that lettuce was very greatly benefited this second winter; that it matured two weeks earlier, and in many cases was very much better and larger. The injury to the plants was very much less, yet all the plants were more or less injured. In those experiments only lettuce seemed to give us a gain.

At this point we were positive that we had been able to cut out at least a part of the injurious effect, whatever it might be, of the electric

light. It seemed to us that we had overdone the matter in forcing the plants to grow all day and all night. We found that the plants grew in the day time as well as the night time, whereas they ordinarily grow in the night time. The tendency with all was to hasten too quickly. They went to seed so quickly that we got very little edible product.

The third winter we modified our experiment by running the screened light half the night. In that way we cut out the injurious properties of the spectrum. We got our greatest and best results under these conditions. I am positive, from all our experiments, which have now been going six years, that on an average we can get lettuce from one to two weeks earlier by means of the electric light running half the night, screened. In fact, it is done at the present day by a commercial house. If any of you wish to investigate the subject you will find that W. W. Rawson, of Boston, uses a two thousand candle power light. His houses are so large that he turns in his teams to plow the soil in them. In the growing of lettuce in a dark climate, especially one so dark as ours at Ithaca, I do not question the influence of a screened arc light, running a portion of the night, as being of great advantage.

Without detailing to you all the intricacies of the various experiments, I may say that we studied for one or two winters the effect of various screens upon electric lights—various colored glasses, opal globes and other screens—and endeavored to determine what was injurious in the electric spectrum.

I wish to show you now a picture of a heliotrope plant, which was selected for experimentation, with two equal branches. It was grown for two or three months with two branches for the purpose of having those branches as uniform as possible. This plant was put before an electric light, some five or six feet away. The plant was placed with a plain window pane in front of it, one branch of the plant being screened and the other fully exposed to the electric light. After two days, we found that branch of the plant which projected beyond the pane and was exposed to the naked arc light, began to be injured. In fact, if a leaf of any of several plants were to project beyond the window pane and be exposed to the naked light, you could see the demarkation as well marked as if it were a photographic plate; and this was especially so with the coleus and other plants of high colors. This may take place within two or three hours after exposure. The result of exposing the plant for three or four nights was, as you can see by this picture, that one branch is almost dead, while the other branch is growing well.

Many other experiments of this kind were tried. We find, then, that the pane of glass cuts out something which is not illumination. That is, it cuts out some part of the spectrum which does not appeal to the human eye and which, therefore, we do not see as light. We all know that the photographic plate is sensitive to parts of the spectrum which cannot be detected by the eye. Let us now photograph the

spectrum of the electric light when screened through a window glass and also when naked. I will pass a photograph showing the two things. Above, you will see the spectrum of the naked arc light. Below, you will see the spectrum of the same light, taken at the same place, with the window glass before it. You will notice that this spectrum is shorter than the spectrum of the naked light. We found that the electric light, hung above the greenhouse, behaved beneficially because the roof screened out the injurious rays.

I should like to say something about the influence of this screened light on plants grown for their flowers. We found that lettuce can be distinctly benefited, and, I think, often to a commercial extent. Radishes have not been benefited to any great extent. Endive is nearly always injured. Spinach and cress are nearly always injured. We have never been able to secure any influence, except possibly an injurious one, on tomatoes. We have perceived no good effect upon cucumbers or beans, and we have always had injurious effects on cauliflowers.

Dr. Myers—How about beets?

Prof. Bailey—We have had contradictory results with beets, and never results that were worth while. In other words, it all amounts to this: That each plant is a law unto itself and each plant must be experimented on by itself. There does not seem to be any underlying principle which can be applied to all plants. But when it comes to the matter of flowers we can perhaps generalize. In a majority of cases the red and purple and violet colors have been more intensified the first few days, but they last a shorter time than do those developed under normal conditions. The Easter lily is a very important commercial product, as you know, and often there has been the greatest difficulty in getting them to bloom at Easter. Part of that difficulty is due to the unevenness of the bulbs as grown in Bermuda; but given bulbs of equal vigor and virility, the grower does not always bring them to a certain stage with equal promptitude. Suppose that a gardener finds, a month before Easter, that his lilies are going to be late in blooming. I believe he can often force them on with the aid of the electric light. We have tried this and have found that we can sometimes create a difference of about a week in the blooming of Easter lilies, by applying the electric light during the last month of the period. If we apply the electric light early in the life of the lily it tends to make it run to flower before it has attained a size adequate to support a sufficient number of blooms; but if put on later in the season, when the buds have begun to form, and the foliage is intact, it can be forced somewhat.

Mr. Twombly—Would you apply it half the night or all night?

Prof. Bailey—Half the night is better than all night. We have given up the idea of running the light all night. In one of our very best experiments, where we gained from ten to twelve days in a crop of lettuce, the electric light ran half the nights and half the days only.

You may be interested to know what is the physiological effect of this electric light upon the plants which are injured. How is it that the plant is discolored? Why do the leaves curl up? Why can you see the line of demarkation just where the window pane ends? It is a very difficult thing to get at the physiology of the coloring matter inside the leaf. The leaf has three general zones, structurally, the upper and the lower zones being the epidermis. There are cells which are more or less flat, like paving stones, and they are transparent. Just underneath these flagstone cells there is a layer of perpendicular cells, which are filled with the normal coloring matter—the leaf green. The epidermis, as I remarked, is transparent, and the green we see is the green of the second layer of cells. Below this second layer of cells is a zone of cells which are more or less loosely united, so that, in the interstices, there is an area which is more or less filled with water vapor. The effect of the electric light is nearly always to hasten activities. The electric light is most marked upon the epidermal cells. It strikes them from above, which hastens the activities of the cells, which call for more water. It calls for the water of the palisade or chlorophyl cells. These exceedingly short rays pounding upon the cells seem to induce a prematurely great activity, calling for more water, which must be supplied by the layer of cells next below. If this goes on long enough the next layer of cells is called upon for water; and with the breaking up of the chlorophyl cells the leaf dies.

The coleus plant, with its very highly-colored leaves, is quickly injured by the electric light, while some other plants are not. In every case where we have made an examination, the coloring matter in those leaves which are quickly and seriously injured lies in the chlorophyl cells, or above them, while we have found, where the coloring matter is disseminated throughout the lower cells, the injury takes place more slowly.

What is the upshot of all this experimenting? It is that the naked arc light is injurious to all plants, so far as we know; that the screened light may be injurious or beneficial, depending upon how long it runs, and also depending upon the kind of plant which is grown under its influence. We have found that running the light all night is too much for the plant. It is "staying up" every night in the week. Running the screened light half the night will give very marked beneficial results with many kinds of plants.

Mr. Sturgis—May I ask the Professor a question? Did you say that this large dealer in Boston put his arc light outside of his glass house?

Prof. Bailey—Yes, outside.

Mr. Sturgis—So that all the light passed through the glass of the house?

Prof. Bailey—Yes.

Mr. Dodge—How large an area does the light cover?

Prof. Bailey—I cannot quite answer for Mr. Rawson's place without showing photographs, but we found a light, hung above a house about sixty feet long, influenced the entire house. The one light above the middle of the house gave almost as great an influence to the two ends of that house as it did to the middle. That is, one 2,000 candle power light will certainly have an influence over sixty feet of space, and I think it will extend one hundred feet.

Mr. Appleton—We will conclude our proceedings by listening to Prof. William P. Brooks, of the Massachusetts Agricultural College, at Amherst, Massachusetts, whom I now have the pleasure of introducing. Prof. Brooks will explain the French and German experiments in attempting to apply electricity to the production of more soluble manures and fertilizers.

Prof. Wm. P. Brooks then delivered the following address: Mr. Chairman and Gentlemen: My subject naturally falls into a number of somewhat distinct topics. Among these I must, for a reasonable degree of completeness of treatment, consider the following:

First.—Normal electrical condition of soil and air.

Second.—The normal electricity of the plant itself.

Third.—The influence of the electric light.

Fourth.—The influence upon germination of electrical stimulation of seeds.

Fifth.—The influence upon growth of electricity applied directly to the plant.

Sixth.—The influence upon growth of electricity applied to the soil in which plants are growing.

Seventh.—Electrical methods of determining soil moisture and heat.

Eighth.—Electric treatment of sewage.

Ninth.—Electric power.

I.—NORMAL ELECTRICAL CONDITIONS OF SOIL AND AIR.

The soil is normally a highly electrified body, its electricity being chiefly of frictional origin, the friction of the particles one upon the other and that of the atmosphere moving over the surface. Rain water also conveys electricity to the soil whose electrical condition varies with the moisture content. It has long been known that electricity is capable of exciting certain chemical reactions. Electrolysis is a well-known result of the passage of the electrical current through numerous compounds. Fischer has shown by experiment that the electric current possesses the property of acting upon some of the soil constituents, rendering the insoluble ingredients more soluble and thus increasing their assimilability. Here we have the first class of useful effects due to this potent agent. It is of course evident that increased availability of soil or manurial constituents may follow as a result of the action of applied and of artificially

conducted electrical currents as well as from the action of the normal currents of the soil.

That the air is the seat of electrical excitement has long been known. The degree of this excitement, as is also matter of common knowledge, varies widely with time and place. With these points we have not to concern ourselves. The one question that concerns us at this time is: does the normal electricity of the air serve any useful function in connection with plant life, under the ordinary conditions of the farm and garden? Upon this point there has been much speculation; and but one point of apparent practical importance appears to be firmly established. Electricity is the most active ozone former in nature, acting upon atmospheric oxygen to convert it into the more active and energetic ozone, the invigorating and vivifying effects of which upon both animal and vegetable life are matters of common observation. Aside from such effects, however, it is important to call attention to two chemical changes induced in nature by ozone which must prove of value in the vegetable economy. 1.—Ozone is an oxydizing agent of great power and must play an important part in rendering soil and manurial constituents available. 2.—It is capable of uniting with the free nitrogen of the air to form nitric acid, the most useful food compound of this most costly element. Evidence of this is afforded by the presence of nitric acid in unusual amounts in the precipitation during tempests, which has been repeatedly observed in various parts of the world.

2.—THE NORMAL ELECTRICITY OF THE PLANT ITSELF.

Examination with a sensitive galvanometer reveals the fact that under strictly normal conditions the tissues of the living plant are the seat of electrical excitement. The presence of positive and negative poles has been demonstrated, the paths of weak currents between them have been traced, the influences which modify the strength of these currents have been studied. Some have been inclined to consider the presence of these currents significant and to ascribe to them an important influence upon the vital functions; but so eminent an authority as Vines dissents from this view, and holds that these currents are the consequence of variation in the amount of water and of movements of water in the tissues of the plant, which cause the disturbance of the electrical equilibrium in its different parts. Some of the latest investigators hold, moreover, that respiration is also a cause of electric currents in plants.

3.—THE INFLUENCE OF THE ELECTRIC LIGHT.

To Hervé Mango, working in 1861, belongs the honor of first showing that the electric light is capable of causing the formation of chlorophyl in plants. Prillieux, in 1869, proved that this as well as other powerful artificial lights causes assimilation; while Dr. Siemens, in England, seems to have been the first who, as a result of his experiments, conceived the

idea that the electric arc lamp would become practically useful in horticulture. To him we owe the term electro-horticulture. Bailey, at Cornell, and a number of private gardeners, among whom may be named W. W. Rawson, of Arlington, Mass., have more recently experimented on the use of the arc lamp in stimulating the growth of hot-house plants; while Rane, in West Virginia, has made similar experiments with the incandescent light. The experiments of Bailey were continued through several years and were characterized by the usual ingenuity and thoroughness of this worker. Siemens had found the 4,000 candle power light, when placed inside the house, injurious when naked. When a clear glass globe was used it was satisfactory. Similar results were obtained by the use of a 1,400 candle power lamp used outside and ten feet above the roof. In all cases, those plants exposed both to daylight and electric light showed a decided superiority over those exposed to daylight alone. Electric light appeared about half as effective as daylight. He found a 1,400 candle power light outside produced a maximum effect when about ten feet above the glass. He showed that injury does not follow continuous light for the twenty-four hours, that the electric light often deepens the green of leaves and the tint of the flowers, that it sometimes intensifies flavor and that it aids to produce good seeds; and he thought the addition of the electric light enabled the plants to bear a higher temperature, which would probably mean more rapid development.

Dehérain conducted a series of experiments in 1889 proving, among other points, that the electric light from arc lamps contains rays harmful to vegetation, but that the greater part of the injurious rays are modified by a transparent glass.

The experiments of Bailey and Rane, while greatly extending our knowledge upon the details of the subject, can hardly be said to have brought out new scientific principles of importance. It is to be regretted that neither has thrown light upon the economical aspects of this question. Both express themselves as believing that the electric light can be used to advantage in the forcing of some plants, but I believe that it has yet to be proven that such use will prove profitable. Mr. Rawson, some years since, assured those who approached him upon the subject that the light proved profitable to him in lettuce growing. In view of the fact that he does not now use it, one is led to wonder whether the advertising value was not the chief item.

In closing what I have to say upon this branch of my subject, I cannot do better than to quote such conclusions of Bailey and Rane as bring out new points.

Bailey found that, under electric light, plants were earlier; that lettuce was greatly benefited, five hours per night hastening maturity from a week to ten days, though newly transplanted plants were injured; that radishes were benefited, but not to a great extent; that beets and spinach were slightly benefited; that cauliflowers grew taller and produced smaller heads; that violets and daisies bloomed earlier.

Rane found the influence of powerful incandescent lamps marked, that lettuce was earlier and weighed more, that flowering plants bloomed earlier and continued to bloom longer, that some plants (spinach and endive) run more quickly to seed, that most plants grew taller. Rane expresses doubt whether incandescent lamps at present prices can be profitably employed even for lettuce and flowering plants.

He, as well as Bailey, believes there is a future for the electric light in horticulture, and so may we. The day for its profitable employment under usual conditions is, however, evidently not yet here.

4.—ELECTRICITY AND THE GERMINATION OF SEEDS.

There have been many somewhat visionary statements concerning the magical influence of electricity in awakening to life seeds which would not germinate under ordinary conditions. Numerous foreign investigators have conducted experiments in electro-germination, among whom Abbé Nollet was the first to secure favorable results, while Specnew later greatly improved the methods in such work. To Dr. G. E. Stone of Amherst, however, belongs the honor of having carried through a greater number of careful experiments than any other observer. He has employed three varieties of current in his work, viz.: the alternating, direct and frictional electricity.

In every day English, he finds: that more seeds germinate when electrically stimulated than when not so stimulated, that germination takes place more quickly, and that both root and stem of the growing plant grow much faster.

He finds the alternating current best. With a duration of stimulation of one minute he finds the alternating current (average of 31 experiments) produces an acceleration amounting to 40 per cent.; the direct current (average of 19 experiments), 27 per cent., and frictional electricity (average of six experiments), 15 per cent.

He finds the most useful current to be a very weak one—a small fraction of a mille ampere—and that the necessary duration of stimulation is short.

You may here naturally inquire whether any practical application has been made employing electrical stimulation to promote germination. The answer must be, no. The methods employed thus far have been laboratory methods only; and Dr. Stone himself frankly admits that thus far he has not demonstrated his discoveries to have practical utility. It seems not unlikely, however, that with seeds of uncertain and slow germination, or in cases where any gain in time is a great advantage, electrical stimulation of the seed before planting may prove useful. The seed must first be soaked, as the electrical current has no effect upon seeds which are not moist.

5.—THE INFLUENCE UPON GROWTH OF ELECTRICITY APPLIED DIRECTLY TO THE GROWING PLANT.

Earlier investigators, working with the direct current passed through the long axis of a root, found that growth in length was retarded, especially when the direction of the current was made opposite to that of growth. Dr. Stone has obtained results which make the conclusion probable that this effect was a consequence of the employment of too strong currents; and here, as in his experiments in germination, he finds the alternating current best. The range of current intensity which stimulates growth appears to be a very narrow one. The minimum alternating current which proves useful is about .006 m. a.; the best is .2 m. a., the maximum intensity exerting a favorable influence is about 6 m. a., while 36 m. a. kills the plant. Dr. Stone believes that the range for the direct current is still less. The alternating current kills only when sufficient heat is generated to destroy the protoplasm. With the direct current electrolysis causes disintegration of the protoplasm.

It must be admitted, in conclusion on this point, that no practical application has been made of the knowledge which we now have concerning acceleration in growth by direct application of suitable electrical currents.

6.—THE INFLUENCE UPON GROWTH OF ELECTRICITY APPLIED TO THE SOIL IN WHICH PLANTS ARE GROWING.

It has been pointed out already that electricity, acting upon the soil, exerts a favorable influence in promoting increased availability of soil constituents, but that the natural currents are weak. With this point established, what more natural than the thought that stronger artificially supplied currents will be likely to prove yet more useful—useful not alone, perhaps, because of increased availability of soil ingredients, but also because stronger electrical influences may thus be brought to act upon the plant itself? We are not surprised, then, to find that electrical experiments in this line have engaged the attention of numerous investigators. Foremost among such investigators have been the French, and a somewhat imaginative account of an electrical farm, by Walsh, which has been recently published, tells of a method of enormously increasing farm and garden crops under the influence of atmospheric electricity collected by means of a "*geomagnetifere*" and passed through a net work of galvanized iron wires buried six feet beneath the surface. Warner some ten years since tried somewhat similar experiments, using, however, artificially generated currents and placing his wires much nearer the surface. Warner experimented with lettuce, carrots, turnips, beets, salsify, radishes, onions, peas and tomatoes. He reported a beneficial influence on lettuce, peas, radishes and tomatoes; but candor compels me to say that his experiments seem to me far from conclusive. His reported gains were in no case important.

More recently Stone has carried through a number of experiments with radishes, using currents of several kinds and differently applied. His experiments were carried out in boxes about 5 x 3 feet and 7 inches deep and no wires were laid through the soil. He employed a copper plate, buried in the soil at each end of the box, connecting each with one pole and making the soil itself between these plates the conductor of the current. Upon this general plan he has made a number of experiments with the utmost care in the use of collected atmospheric electricity, constant currents of varying strength, and alternating currents (stimulating for a few seconds each hour). He has also tried experiments in which, by the use of a copper plate at one end of the box and a zinc plate at the other, the acids of the soil have served to make these plates generators of galvanic electricity, producing weak currents through the intervening soil. Stone has been careful to measure his currents and to most carefully regulate their strength.

He finds an increase in crop in all cases. In one set of experiments, atmospheric electricity gave 27 per cent. gain in roots, galvanic (1 m. a.), 164 per cent.; constant current (2 m. a.), 17 per cent; alternating current (a few seconds per hour, 5 m. a.), 16 per cent.; and constant (5.3 m. a.), 16 per cent. Two other experiments have given nearly the same percentages of increase from the alternating current; while one other with galvanic electricity gave 51 per cent. and another only 3.7 per cent. The last experiment was completed late this Fall, and conditions were less favorable than in the others for good growth.

The facts, as presented, make it apparent that under some conditions electricity applied to the soil causes greatly increased growth. The system, needless to say, is not yet upon a practical basis, and whether profitable economic results will ever follow the employment of this agency is yet uncertain. The use of the galvanic current, generated by suitable strips on either side of hothouse beds, in the culture of crops not injured by a moderately acid condition of soil, would seem practicable.

THE APPLICATION OF ELECTRICITY IN AGRICULTURE.

That it should long have been dreamed and believed that the mysterious "something"—which scientists, though it has been known in some of its manifestations for more than twenty-five centuries, are still unable to describe, save by a statement of some of its phenomena—might be usefully applied in agriculture, is not in the least surprising. So wonderful are the countless manifestations of this modern wizard, that it is only natural that it should have been regarded as close to the well-springs of life, if not actually life itself. The lightning, flashing in beauty and in awful energy through space, the subtle fluid harnessed, in these latter days, in countless ways, in the service of mankind, leaping the continents and the oceans to carry his messages over pathways pro-

vided by man, and, latterly, seeming proudly to spurn the trammels thus imposed, flashing these messages through space; giving wings to man's voice; transferring the lines traced by his pen, the lineaments of his face, even, over thousands of miles, with the speed of light; doing upon our streets and rails the work but recently done by the horse and that modern dromedary, steam; lighting and warming our homes—what may not this *ether* or this *force* do for the farm? Surely, if we can but find out the way, it must bring countless benefits. This has been the natural thought. It seems to me to be the inevitable conclusion. The earlier speakers of the evening, especially, have shown that there is a direct relation between electricity and plant life in many ways, especially in the supplying of plant food. But, as you have seen, your doctors do not agree. The long and short of the matter is that we do not know enough about the applications of electricity to advise anything which is really practical, but we should not, therefore, be discouraged. I fully believe that in the future, and I hope in the not distant future, speakers will be able to appear before you who can tell you a very different story.

A vote of thanks to the speakers of the evening and to the steward was unanimously passed, after which the Farmers adjourned to meet on Tuesday, February 20, 1900.

The

"New York Farmers"

HELD their final meeting of the season of 1899–1900 at "Sherry's," corner of 44th Street and Fifth Avenue, on the evening of Tuesday, February 20, 1900, the President in the chair.

Mr. Appleton, in opening the proceedings, spoke as follows: The subject for discussion this evening is "Fertilizers and their Application." I have the pleasure of introducing to you as the first speaker to address you, Prof. W. H. Jordan, of the New York Agricultural Experiment Station, at Geneva, N. Y.

Prof. Jordan then said: Mr. President and Gentlemen—You have honored me with an invitation to speak to you to-night on a subject of great economic importance.

When we consider fertilizers and their use, we are dealing with the fundamentals of plant production, and plant production is fundamental to individual and national prosperity. A fertile land may be the abiding place of a prosperous people but the depletion of the soil of the necessary elements of plant growth will ultimately bring disaster to all human activities.

The fertilizer trade is, or ought to be, a trade in plant food. Moreover, it involves, or should involve, the buying and selling of those ingredients of the plant which nature fails to furnish in abundance or which, because of the methods of agriculture adopted, are in time exhausted from the soil. This trade is extensive. Not long ago Mr. Dodge, of the United States Department of Agriculture, estimated that there were approximately a million and one-half tons of mixed fertilizers sold in this country at a cost to the farmers of not far from fifty-three millions of dollars. The trade in the State of New York amounts annually to a sale to consumers of probably not less than one hundred and fifty thousand tons, which means an expenditure from the farms of not less than three and one-half to four millions of dollars. These figures disclose the fact that the fertilizer trade is one of the important commercial enterprises of the country. It is not only important in extent but is important in what it accomplishes as a means of conserving and developing our resources for plant production, and we shall see the force of this statement when we consider the sources of the materials from which fertilizers are made.

The raw materials which the fertilizer manufacturer uses are of three general classes; those supplying phosphoric acid, those containing potash and those which are a source of nitrogen. In the early history of the trade phosphoric acid was obtained almost wholly from bone, which is largely a refuse material of our slaughter-houses, and which has also come to us from South America in the form of bone ash. If our supply of phosphoric acid was to-day limited to that which can be obtained from bone, this trade which we are discussing would not maintain its present magnitude, because the greater part of the agricultural phosphates are obtained from the various mineral deposits of calcium phosphate which are found in this and other countries. As a matter of fact the phosphatic rock deposits in Tennesee, South Carolina, Florida and other States are to-day our chief source of phosphoric acid. This rock is mined in the States mentioned, is finely ground and, after being treated with sulphuric acid, becomes what we know in the market as acid phosphate, and, when combined with nitrogen and potash compounds, serves as the basis of our mixed fertilizers.

The question often arises whether phosphoric acid from these mineral deposits is equally valuable with that from bone. It is clearly demonstrated that when crude rock is treated with sulphuric acid and the phosphoric acid is made available, it is just as useful as when obtained from bone in a similar manner. It is probable, too, that very finely ground rock, even without treatment, is more nearly equal to bone in crop producing power than most persons believe.

The potash of our fertilizers now comes to us from foreign sources, whereas wood ashes formerly furnished our only supply of this ingredient. We now depend almost wholly upon the products of German mines, and it is safe to say that all of this compound which appears in our mixed fertilizers is imported. The potash salts with which we are most familiar are the muriate of potash, the sulphate of potash and kainit, all of these varying somewhat in their proportions of potash.

Nitrogen has a variety of sources. It is found in natural deposits and is obtained in useful form in many of the waste products from our manufacturing processes. One important source of nitrogen is the nitrate of soda, which is shipped to us from Chili. There is certainly no more valuable form than this, because the nitrogen of this compound is immediately available and is generally depended upon to produce an immediate and rapid growth of young plants.

Sulphate of ammonia is a waste product from our gas manufactories, which contains a high percentage of nitrogen, but the supply of this material is somewhat limited.

The greatest variety of nitrogen-supplying materials is what are called ammoniates, the most important being waste products from slaughter-houses. We have dried blood, tankage, cotton seed meal, horn and bone, all of which, with proper treatment and preparation,

supply nitrogen available to crops, the three first, when they are what the names indicate, being the most valuable. It is unfortunate, but nevertheless true, that other nitrogen-bearing substances of an inferior character have found their way into the fertilizer trade. I refer to hair, wool waste and even leather. These materials have been so manipulated that it has been possible to introduce them into mixed fertilizers in such a way as to make their presence difficult of detection. In chemical examination the nitrogen which they contain counts for as much as that from any other source, and it is one of the limitations of fertilizer inspection that we are not able to point out with certainty what proportion of the nitrogen in mixed fertilizers comes from desirable sources. These, then, are the principal sources of our plant food. The substances which I have mentioned are prepared in various chemical and mechanical ways by machinery which has reached a high degree of efficiency and after being mixed in varying proportions are put upon the market under a great variety of names.

It is interesting to consider the causes which are fundamental to the rise and growth of the fertilizer trade. Science is often held responsible for our commerce in plant food, and there is certainly good reason for this claim, because it was science which first pointed out what are the constituent parts of vegetable tissue, and that discovered those elements which are absolutely essential to the normal development of the plant. Without the chemist we would not have discovered the natural sources of the phosphoric acid, potash and nitrogen which the plant must have. In doing this science has rendered humanity a great service, because in this way we are now able to use the natural deposits of phosphoric acid and potash and also the wastes which otherwise would have little or no value, in order to fortify ourselves against the day of sterile soils, or better, perhaps, to entirely prevent that day. It is vastly important to humanity that we now know where to go for those compounds which are fundamental to human existence and that we are now able to provide against the depletion of our soils by stopping wastes and by utilizing materials which would otherwise be rejected as worthless.

The experience of the practical man is also in part responsible for the fertilizer trade. He has observed many times that the roots of plants fasten themselves to bones and that where the ashes from the fireplace are spread plant growth is quickened. The luxuriant vegetation which springs up when an animal has decayed, or where any animal refuse has been thrown and allowed to decompose, has also been to the farmer a practical lesson. Just as soon, then, as science was able to point out to the agriculturist why the bone and the decayed animal matter sustained plant life, he was able to utilize in a systematic way these sources of plant food.

Science is also able to assure the farmer that there can be no substitutes in feeding plants. It has been demonstrated for his guidance

that iron cannot take the place of lime, nor can sulphuric acid take the place of phosphoric acid. Years of experience and investigation have shown, also, that the three ingredients which are the weak links in the chain of plant life, so far as natural supply is concerned, are nitrogen, phosphoric acid and potash. In these various ways we have been led into the commercial distribution of nitrogen, phosphoric acid and potash, these being the ingredients upon which the value of our commercial fertilizers is wholly based.

It is to be regretted that the commercial fertilizer trade has not developed in this country in a manner which is at all comparable with its proper dignity and real importance. I refer now to the abominable trade names and to the undesirable methods of selling which attend this commercial effort. The first fertilizer in the market was guano, which consisted of deposits of the excrement of birds in rainless regions. This fertilizer was known as guano and sold as guano. As soon, however, as the enterprising Yankee began to gather together the waste materials from the ends of the earth, and manufacturing establishments began to multiply, it seemed to be necessary to establish trade names in order to distinguish the products of one manufacturer from those of another. Doubtless these trade names were necessary. The unfortunate side of the matter is that they have become multiplied to an absurd extent and have become ridiculous in their phraseology; in other words, the enterprising Yankee, in his desire to make an impression upon the rural mind, has applied to the fertilizer trade the undesirable methods which pertain to the exploitation of patent medicines. The use of such names as "Sure Crop," "Acme," "Mortgage Lifter," "Success," "Phoenix," and the like, have, I believe, in the long run, done the fertilizer trade infinite harm, because the intelligent portion of the community has come to look upon these high-sounding names as covering up the same deception and unwarranted claims that pertain to a patent medicine which consists of the most common materials and which is advertised as curing everything. There is a great disparity between the high function of nitrogen, phosphoric acid and potash in sustaining human life and in aiding the prosperity of the farmer and the utterly foolish and absurd proprietary names under which these elements of plant food are urged upon the public. I think that many of the men most largely engaged in the manufacture of fertilizers recognize the truth of the statements which I have been making and would be glad to see all this changed. The time should come, and I believe ultimately will come, when we shall buy and sell nitrogen, phosphoric acid and potash as we buy and sell nails and flour and lumber.

There has also grown up a method of selling commercial fertilizers which is certainly not economical, and which, because of the manner of exploiting these goods, has brought more or less disfavor upon the

trade. I refer to the system of local traveling agents, combined with the selling on credit. It will not be possible for me in a few brief words to make you understand why I have come to deplore and almost despise the arguments which have been so largely used in inducing farmers to buy fertilizers. The facts of science have, in the mouths of men having no right to discuss the nutrition of plants, been distorted, misapplied and twisted into all sorts of relations in order to convince the farmer that he ought to buy a particular brand of goods. The intense competition which has prevailed because of the numerous manufacturers in the market has led to unfair and even dishonest comparisons. I remember that in the case of a competition between two brands of acid phosphate the agent representing one declared that the competing brand contained free acid which was injurious to the soil and which his company was removing at a cost of a dollar a ton. This was given as a reason why one brand of goods should be bought rather than the other. This is a single instance out of many which have come to my attention; which means that sharp practice has often been indulged in in the selling of fertilizers. Nor do I think the manufacturers can be held blameless in the matter of methods of advertising. They have appealed to science, more intelligently, perhaps, but often just as unfairly, as the more ignorant agent. Half truths have been quoted and the results of investigations by experiment stations have been used out of their right relations in order to make it appear that this or that brand of goods was superior to some others. Allow me to assure you, however, that many of the men engaged in the fertilizer trade are as honorable and as clean in their methods of business as any found in the commercial world. I speak of these matters because I would like to see a reform in the direction of more reasonable and more economical methods, and I trust that the fertilizer combination which has recently been affected will do what it can in the direction of placing the sale of plant food upon a thoroughly sound and dignified basis.

It is hardly to be expected on this occasion that I should ignore the subject of fertilizer inspection, because for nearly fifteen years I have had the responsibility of administering laws providing for the analysis and inspection of fertilizers.

Two facts led to legislation, the fundamental one being that dishonest practices had arisen in the fertilizer trade, which, coupled with the inability of the consumer to determine the composition and value of the fertilizer from its appearance, made it necessary for the law to throw some protection around the purchaser of commercial plant food.

There are several ways of practicing fraud in compounding a fertilizer. One is by the use of a filler, such as coal ashes, in order to dilute good materials, and so reduce the percentages of valuable ingredients below the advertised figures. Another dishonest practice is to introduce into the fertilizer such substances as hair, wool waste and

ground leather. Notwithstanding the fact that many manufacturers have maintained their goods at the advertised standards and have used good materials, it is unquestionably true that brands of inferior composition have been sold at excessive prices and waste products almost worthless have been introduced into the mixtures.

There are, at present, twenty-nine states which have enacted fertilizer laws. These laws require in general that the bags containing fertilizers shall have attached to them in some plain manner the name of the manufacturer, the guaranteed percentages of nitrogen, phosphoric acid and potash soluble in water and the weight of the package. The statement found upon the bags must also be filed with the executive officer of the law, and in nearly all cases some form of tax, either as a license fee, an analysis fee or a tag tax, must be paid on each and every brand sold or offered for sale. These are the requirements laid upon the manufacturer or dealer. On the other hand the experiment station, board of agriculture, or other institution having the execution of the law in charge, is required to collect samples of the various registered brands of commercial fertilizers found in the market, analyze these and publish reports or bulletins showing the standing of these fertilizers as compared with the guarantees. A failure to maintain the composition of the goods up to the guarantee is an offense against the law and is punishable by fine. It is very seldom now that a fertilizer is found in the market which is greatly inferior to the advertised claims—that is, so far as the percentages of nitrogen, phosphoric acid and potash are concerned.

The value of these laws consists not in what is found but in what is prevented. The first experiment station which was established in the State of Connecticut having for its object in particular the inspection of fertilizers, discovered some serious frauds, one especially being that of a mixture called Poplein's Silicated Fertilizer, which contained per ton approximately eight hundred pounds of silicious earth, having for its source that honest state from which my good friend Prof. Voorhees hails. During my own experienee in executing fertilizer laws, I have known of several instances where inferior goods have been driven out of the market. Reputable fertilizer manufacturers recognize the good which these laws have accomplished and they regard them as the safeguard of honest goods. They have stated to me repeatedly that they are entirely willing to pay whatever tax the law imposes, because of the direct benefits to their business. These laws should not be regarded as existing wholly for the benefit of consumers, but also for the protection of manufacturers.

Several facts connected with this inspection in the State of New York may possibly be interesting to you. Until the present year the expense of this work has been borne by the State Treasury, ten thousand dollars having been appropriated annually for this purpose.

In other States, as I have said, the trade has been taxed to pay the cost of inspection. The result of this situation has been that the trade has developed somewhat differently in New York than in some other States. So long as there has been no tax on each brand the manufacturers have found no obstacle to the multiplication of brands up to an absurdly large number. In 1898, about nineteen hundred brands were registered at the station; and, in 1899, two thousand two hundred and sixty-eight, the number of manufacturers during the past two years being not far from one hundred and ninety. This conditions of affairs has come about through the making of what has been known in the trade as "specials." John Doe, of Doeville, who has been an agent for many years and who has acquired a reputation as a seller of fertilizers, concludes that it would be a good stroke of business to have a brand of goods with his name attached to it, so the Blank Fertilizer Company, of Blankville, whose goods he has been handling, is requested to make a brand to be known as Doe's Potato Phosphate. As soon as it is known that Doe is doing business in this way, Mr. Smith, over at Smithville, desires to do the same. After a while some fertilizer company other than the one located in Blankville finds that this method of trade has its apparent advantages, and proceeds promptly to adopt the same plan in its own business, and finally competition requires all manufacturers to accede to the demands of agents for special brands. It is not to be supposed, for instance, that these different brands represent any especial differences in composition. I have been informed by manufacturers that Smith's Potato Phosphate and Doe's High Grade special are often taken out of the same pile as Doe's Potato Phosphate. Small lots of goods are often sold under such names, and, because of the brief time occupied in transportation and distribution, many of these specials have escaped inspection. In fact, it was impossible for the Experiment Station to properly inspect over two thousand brands of goods, by the use of any sum of money which it would be reasonable for the State to appropriate to that purpose. Moreover, such a multiplication of names was confusing to the consumer and in the long run unfortunate for the manufacturer. It was for these reasons that we asked in the winter of 1899 for an amendment to our Fertilizer Law requiring the payment of a license fee of twenty dollars on each brand of goods sold or offered for sale. This change in the law, together with the combination of the fertilizer interests which has occurred during the past year, has resulted in diminishing the registration of manufacturers to less than one hundred and the number of brands to a little over five hundred. It is not to be supposed that there are any less real manufacturers than was formerly the case, because previously many persons posed as manufacturers who were really only mixing manufactured articles or were dealing in mixed goods prepared by other parties. These practices prevail to some extent now. As a matter of fact, there is no reason for the exist-

ence in the market of more than a dozen different mixtures of fertilizing materials, because our knowledge of the needs of various soils and crops and localities is not sufficiently accurate to enable us to apply intelligently more than a few combinations of plant food.

I am aware that in one or two instances small manufacturers, who have been working up a local supply of bone and other refuse materials, feel that this license law is in the interests of monopoly, because these local enterprises are not able to pay a license fee on the small amount of manufactured product which they put out. There may be some truth in this claim. It must be said of all laws that they are framed to promote the greatest good of the greatest number, and there are doubtless some cases of apparent injustice. On the other hand, it is certain that the restriction of the number of brands is in the interests of the consumer as well as of the manufacturer. So long as there are one hundred manufacturers doing business and over five hundred brands on the market there can be no lack of competition and prices will be regulated by supply and demand as has been the case in the past. A material advance in the prices of fertilizers for the year 1900 has been credited by some to the requirement of the payment of license fees. This certainly must be a false view of the matter, as is easily shown. The license fees for 1900 will amount to about ten thousand, five hundred dollars and the number of brands sold may fairly be estimated at one hundred and fifty thousand tons. You can easily calculate from this that the cost of license fees per ton will be exactly seven cents. It is absurd to credit the advance of three or four dollars per ton to this insignificant factor. There are others, also, who believe that the greater cost of fertilizers during the present year is due to the combination of fertilizer manufacturers. It is not strange that this view of the matter is taken. Very naturally, when the formation of such a combination and an advance in price occur at the same time, the one will be taken as the cause of the other. I have been assured by a representative of this fertilizer combination that this advance is really not more than is justified by the increased cost of manufacturing fertilizers. He stated to me that the phosphatic rock as mined in the South is now costing three dollars per ton, where it has previously cost less than a dollar and a half and that the water freights between Southern and Northern ports have doubled. With the real facts I am not personally familiar, but I am somewhat inclined to the view presented by the manufacturers, because in my judgment there is still sufficient competition with firms outside of the combination to prevent undue profits. This combination of fertilizer interests will, in my judgment, fail in its opportunity if it does not, as rapidly as possible, reform the methods of trade and the manner of promoting the sale of commercial fertilizers.

The use of such absurd names, and undesirable conditions prevailing in the agent system, should be swept out of existence and the trade

placed upon a basis comparable with the dignity and importance of the uses which are made of commercial fertilizers.

Early in the year my attention was called to what was regarded as an attempt on the part of the fertilizer combination to prevent the sale to consumers of chemicals and raw materials. There seemed to be some indications that the manufacturers were making a serious effort to discourage the purchase by the consumer of acid phosphate, muriate of potash, nitrate of soda and other similar chemicals in order that he might mix his own goods. It is certain that at that time no company representing the trust had placed itself in a position to legally sell chemicals. The only manufacturer who on the first of January had registered potash salts and nitrate of soda in my office was one not in the combination. Notwithstanding the statements which the manufacturers of fertilizers may be inclined to make, it would be a great misfortune to in any way handicap the sale of these unmixed materials, because there are to-day hundreds of intelligent farmers, gardeners and fruit growers who are using acid phosphate alone or potash alone, or special mixtures which their own experience dictates to be wise, in a way that is productive of great economy in the application of plant food. I do not know whether it is just to accuse the fertilizer combination of any such purpose as is mentioned, but I do know that since the matter has been freely agitated two companies at least which are in the fertilizer trust have complied with the law with reference to the sale of chemicals.

And, finally, I state to you in all seriousness that the fertilizer mixtures that are to-day found in the markets have no intelligent relation to the needs of consumers. I mean by this that there are no scientific facts or observations of practice which show that 8.8 per cent. of phosphoric acid, 4.9 per cent. of potash and 2 per cent. of nitrogen, which are the averages for all goods sold in 1899, is a better general proportion in which to use these ingredients than some other might be. We are not able to state whether or not it would be better to use less potash or less nitrogen. As a rule the men who are responsible for mixing fertilizers are persons who have no special knowledge concerning plant nutrition or the needs of their patrons. No general facts are applicable, either, because the needs of one producer are not the needs of another. The absurd things of the fertilizer trade do not all pertain to names. For instance, there are many potato fertilizers, so-called, in the market, but there is no agreement among them as to composition. A compounds one which has 8 per cent. of potash and B puts out one which has 4 per cent. of potash, and both are potato fertilizers. Which is the proper one? Are they based upon the composition of the crop? If so, there should be some uniformity. If not based upon the composition of the crop what are the facts which control the proportions of ingredients? Besides, we have special formulas for all varieties of crops. Careful examinations of these show that they have no uniformity and have no

relation to any set of facts whatever. They neither conform to the composition of the crop nor to any principles which are known to science.

It is often true that a corn fertilizer will produce as good or better results with potatoes than any one of the so-called potato fertilizers. As a matter of fact, friends, it is not the crop nor the season but the particular soil which is to be treated which largely determines the agricultural value of any particular combination of fertilizer ingredients, and no agriculturist is conducting his business intelligently who fails to make a study of the effect of these ingredients used separately and in various combinations upon his soil. It should not be said that it is not possible for a farmer to do this, because many farmers have by so doing saved themselves much unnecessary expense.

There will always be a portion of the agricultural community which must take the verdict of another man, and for these who are unwilling to give intelligent consideration to their business, the mixed fertilizers of the market are doubtless of value if used in moderate quantities. The existence of commercial fertilizers should be no excuse for the lazy farmer, as I am sure they have been to some extent. The fact that it is possible to procure plant food ready for immediate use should be no excuse for wasteful and careless methods of handling and developing the resources of the farm. It is possible to maintain the farm in a high state of fertility without using a pound of commercial plant food, and it is to the end of inducing greater care in the saving of home resources that we need at this period of our agriculture to most seriously address ourselves.

Gentlemen: I thank you for your kind attention and for the pleasure and honor of being invited to participate in the enjoyments and privileges of this occasion.

Mr. Appleton—Gentlemen: I now have the pleasure of introducing to you, as the speaker who will next address you, a gentleman from New Jersey, Prof. E. B. Voorhees, of the New Jersey Agricultural Experiment Station, at New Brunswick, N. J.

Prof. E. B. Voorhees—Mr. President and New York Farmers: It gives me a great deal of pleasure to be here this evening. My experience as a teacher of farmers has been such as to lead me to believe that it is very desirable in the beginning of any instruction that I intend to give to attempt to get the sympathy of the audience. So, in my speaking throughout the State, I have often been obliged to do what is vulgarly termed "playing to the galleries," in order to get the sympathy of the farmers. In order that I may have your sympathy, therefore, I say to-night that I am a horny-handed son of toil myself, and I shall speak to you from a very practical standpoint, so that you may carry with you to your farms some ideas which will enable you to increase your crops.

Prof. Jordan has very kindly laid the foundation for a talk upon the use of commercial fertilizers. That is the side of the question that appeals to all of us practical men—how to use these materials in order that we may get a return upon our investment. He has already told you of the various conditions, from the commercial side, which have a tendency rather to befog the practical man than to make things clear for him in order that he may get a return on his investment in commercial fertilizers. I think one great difficulty is that we do not appreciate as we should exactly what we are doing when we are using commercial fertilizers. That is illustrated very nicely by the comments we hear and the letters we get from farmers, and from those who are, perhaps, not as practical as we, concerning the question, "What is a manure?" and whether this substance or that substance would not make a good manure? Now, there is a very distinct difference between the ordinary idea of a manure and the commercial fertilizer, because manure possesses two distinct functions, the function of adding to those constituents in the soil which are essential to the growth of crops, and the function of adding to the productive capacity by making that which is already in the soil more available to the plant. We must clearly distinguish between that which adds to the soil something which was not there before, and that which makes available that which is already there. In the first place, we must understand the function of the commercial fertilizer. Its function is not to make available other constituents, but to add to those which are already in the soil. Now, as Prof. Jordan has told you, what we add of value in the commercial fertilizer consists solely of three constitutents, nitrogen, phosphoric acid and potash; and in the applying of these to the soil we add, in the first place, to the potential fertility of that soil that which was not there before, and which may be represented by an increased crop. In the next place, the commercial fertilizer has the function of a stimulant, in a certain sense—and in its right sense. That is, by adding the right kind of material at the right time, we are enabled to feed that plant with just what it wants, at the time it wants it, and are thus able to overcome other conditions under which it would not reach its full development. So, with this idea of the function of the commercial fertilizer clearly in your mind, let us look at the methods by which they may be used, so as to result in an increased crop.

In the first place, it is not altogether a question of the constituents themselves. I mean by that that it is not a question of nitrogen, for example, but a question of the form of that nitrogen. We add nitrogen to the soil in the form of leather, as has been suggested here to-night, and we may wait for a long time before we may expect a return in an increased crop from that nitrogen. Yet it adds to what is called the potential fertility of that soil. Now, I say it is not a question altogether of the nitrogen, but it is a question of the form of nitrogen, whether

that which we add is capable of entering into the plant itself, whether the plant is able to take it out of that soil and make plant tissue of it. We must therefore distinguish between the thing itself and the form in which it exists. A commercial fertilizer, in the first place, consists of nitrogen, phosphoric acid and potash; and, in the second place, it must be in a form which is available more or less to the plant; so that we run through the whole gamut of availability from the nitrate of soda up to leather, both of which represent forms of nitrogen. So that it is a question not only of the material itself, but of the form in which it exists, in the matter of producing any very great influence upon the development of the plant.

Then let us look at this matter from the practical standpoint in the growing of crops. We will say it is not a question always of considering whether or not a thing is immediately available; the question is whether it is available enough for the plant to which we apply it. That brings up the question right away of the differences in the habits and growth of plants, thus making it possible to use a large number of materials, varying in their availability, which will give us profitable return because the kind of material is suited to the kind of plant. If we think a moment we will recognize that there is a number of kinds of farming, in which a series of plants are included which vary in their characteristics of growth. All of those things have an influence upon the possible profit that may be derived from the application of a commercial fertilizer. Let us take the matter of general farming, for example; and by that I mean the growing of those general crops, such as corn and oats and wheat and hay. Those crops are grown not for any specific quality that they may possess in their early growth, for their succulence or their richness in a certain sense, but for their mature grain, for their final product. They grow through the entire season; and they will be able to gather from soil sources relatively more of the plant food than a plant which is grown for a specific purpose, like a market gardening plant, grown quickly in order to get it to the market early, which must thus have some special stimulating material to force it along. So that the commercial fertilizers for crops of that sort must be of a different character from the fertilizers applied to crops that are grown quickly and for a specific purpose. We may, therefore, take the substances which are not so quickly available, but which, because of the conditions of soil and climate and season and all that, are gradually converted into activity and which contribute in the long run to the full maturity of the plant. Now, as I say, it is a question whether we may expect a return from the use of certain materials. Then, again, from the profit side, it is a question of the value of the crop. Take this lot of crops that I have just mentioned, and they are crops which may be regarded as having a low market value and a high fertility value. That is, the market price of a ton of wheat, at a dollar a bushel, is about thirty-three dollars.

Now, the fertility value of that ton of wheat—that is, the material which that ton will gather from the soil—is high. If we value the constituents of the fertilizer in that crop, at the rate that we have to pay for our commercial fertilizer, we find that the ton of wheat takes from the soil constituents that would cost us six or seven dollars, while we receive for it, at a dollar a bushel, about thirty-three dollars a ton. The commercial value is low, the fertility value is high, and, therefore, we are not justified in applying to that kind of crop a very expensive commercial fertilizer, because, even with a very large increase in yield, we could not expect a return that would be largely profitable. So that in crops of that sort we have got to be a little more particular in the application of our materials, in order that we may get a profit out of it, than in the case of crops of the reverse nature—that is, a high fertility value with a low commercial value. To illustrate my point further, I might take the fruits, or asparagus, a market garden crop which is a very striking example of the high commercial value and low fertility value. A ton of asparagus at ten cents a pound will bring about two hundred dollars; and yet that ton of asparagus will remove from the soil fertility that could be purchased for a dollar. Now, when we come to the application of the commercial fertilizers to the various crops, you see that we must remember that there is a relation between the value of that crop and the kind of material that we shall apply to it. The farmer who is growing asparagus can afford to apply forty or fifty dollars worth of fertilizing materials to his asparagus crop. Why? Because he gets a larger return from it. But he could not afford to apply that to his wheat, or oats, or corn, simply because, if he got the full benefit of it in his crops, their increased value would not be sufficient to pay so large a return, on account of their lower market value. Now, let us look at this in our application to the practical affairs of the farm. The man is growing corn, oats, wheat and hay. The question arises at once, because this kind of farming is a larger business than the growing of asparagus or the growing of market gardening crops. It is more general. It is a vital question with four-fifths of the farmers of the Eastern States, whether they can afford to apply commercial fertilizers to crops of that sort; and the answer is, if it is intelligently done it is a profitable operation, but it must be intelligently done. In the first place, it must be done in a systematic way. The farmer must apply those kinds of materials which are liable to contribute most largely to the development of that crop. Now, I confess that it is a very difficult question to answer, just what, under all the circumstances, is the one thing more than another which is more likely to contribute to the growth of the crop. Of course you will all understand that that depends a great deal upon the character of the soil and its previous cropping and that sort of thing. At the same time we have a sufficient amount of information—not enough, but a sufficient amount—to lead us to intelligently suggest the

materials that shall be applied to crops of that sort. Take a rotation of corn and oats and wheat and hay, which is the general rotation. It is not a good one, but it is the general rotation in the Eastern States. Let us take up corn, in the first place. Corn is a crop which is regarded as a gross feeder. We all say that corn will grow where other crops will not grow. That is, it is capable of taking out of the soil a larger proportion of material than crops of the same weight of another kind. That is not due to the fact that it is corn. It is due to the fact that it makes its most rapid growth at a season of the year when the conditions are most favorable for rapid change in the soil constituents. What the farmer needs to do in that case is to apply to that crop that material which will contribute most towards that end. He can take his rough yard manures, and perhaps a little acid phosphate, something more or less in a crude state, from which, because of the activities that are going on during the Summer, the corn will be able to extract enough to make a maximum growth, where otherwise it would not do it. By applying small amounts of these materials he will be able to lift up his yield from say 25 to 35 bushels per acre, and with a minimum cost, and the increase that he gets, although it is not large, from a commercial point of view, is large enough to make it pay him for the application. But it must be systematic.

We follow the corn with oats. Here we have another crop that is very different in respect to its season of growth, as well as in its character of growth, from the corn. It is a crop that is sown early in the season, and because it makes its growth largely before the conditions are favorable for the development of nitrates in the soil, or before the conditions are favorable for rapid decay, or the changes that take place, we must add to that soil something which will push it along and thus overcome the natural tendency to pout, which we all say is a characteristic of oats. I believe that pouting of oats which is observed by practical men is due not to any inherent characteristic of the oats but to the fact that at that season of the year there is not available in the soil a sufficient amount of active material to make that plant grow right off. It has to wait until the conditions are favorable for a change. The farmer, therefore, if he is going to get a profitable return from the crop of oats, must apply something which will supply the immediate needs of those plants, and which needs the soil is not prepared to supply. So we apply a little nitrate of soda and available phosphoric acid. Put the seed in the ground and the little roots begin to start, and immediately they come in contact with food in an available form, food that was not there before, and could not be because the conditions were not such as to cause it to be prepared and were such as to take it away. All soluble nitrates had been probably carried off. What is the result of this light application ? The result is that we get a larger yield, not so much because we have added a large quantity of material to that soil, but because we have

added the right kind at the right time. The application of a little of that material to the crop, then, will result in a much larger crop than if the farmer had applied some of these indiscriminate mixtures. Following the oats the wheat is seeded and we add the phosphates and nitrates, something which will start off the plant in the fall of the year and give it a good hold on the land; and then, in the Spring of the year, if the plant is weakly or sickly, or if the soil lacks fertility, as shown by the size of the previous crops, we may give the plant another dressing of nitrates, something which will supply the needs of that plant at the times it requires it most; and by a minimum application we get a maximum result.

Following that we come to the clover. The usual seeding time in this section, New York and New Jersey, is to seed the clover with the timothy alone in the early Fall, or with wheat in the Spring. The first cut after the wheat is usually a crop of clover; because the clover belongs to a different group of plants than the oats or corn; and because we have been adding phosphoric acid and potash in available form, in excess of the demands for the crops that have been harvested, we have a surplus of these minerals for that plant to feed upon. As the clover gathers nitrogen from the air we do not need to apply nitrogen, but simply to provide it to have an abundance of the mineral element. That crop can take from the air the necessary nitrogen, and we are accumulating that which will feed other crops. Then we follow with the timothy and then the grass crop again, a plant which is specifically benefited by the application of soluble nitrates early in the season. Why? Because it is a plant that requires in its growth an abundance of nitrogen, and because it makes its maximum growth before the conditions are favorable for the development of the nitrates in the soil. And so, by a top dressing of nitrates again, we have been able to get a relatively large yield by a minimum application of materials.

Now, in the course of that entire rotation the results have shown that it is a very practical method of using commercial fertilizers on those crops which have a low commercial value but which have a relatively high fertility value. The cost of the application for the entire rotation need not exceed six dollars or eight dollars per acre for the entire four crops, and yet I have known of many cases where the returns have been increased by 25 to 50 per cent. In fact, in our own experience during the past few years, a mixture of one hundred pounds of nitrate of soda, twenty-five pounds of acid phosphate, twenty-five pounds of ground bone and twenty-five pounds of muriate of potash—taking those materials and mixing them together and applying them to timothy in the Spring of the year at the rate of about two hundred pounds per acre, or a dollar and a half or two dollars worth of materials—has resulted in increasing the timothy crop by a thousand pounds per acre. We can easily calculate that the constituent elements in that application were more

than sufficient to make that increase in crops; so that we know we have not recovered in that application a very large proportion of the materials that we have applied, making it an entirely practical method of working. Not only that, but a continuation of this systematic intelligent application of materials will result in the constant increase in the potential fertility of that soil, so that after a while we reach the situation where we have the crop up to that point where it is measured, not by the conditions of soil, but by the conditions of climate and season.

I was very much gratified a few days ago to get a letter from a prominent gentleman who has a farm in Morris County, in our State. He said that he had followed a system of this sort for the past fifteen years, at the suggestion of the experiment station. He gave me the yield of his corn for the past year as compared with the average of its growth for the years preceding the method of fertilization, and it was a very remarkable yield indeed. He says that it is entirely practicable, and that it results not in a large expenditure but in a gradual increase in the yield of crops, together with a gradual increase in the natural or the potential fertility of that soil.

Now, let us go for a moment over to the other side; that is, to the special line of crops which possess the opposite characteristics referred to, viz.: high market value and low fertility value. We have in our State a whole series of these special crops. We have the asparagus district, the sweet potato district, the pea district, the tomato district, the fruit district, and all that. All these specific crops have been studied with reference to their needs. They have not been studied as much as they ought to be, perhaps, but we have been able to get hold of certain facts which, if observed, will enable the farmer to increase his crop by an application of commercial fertilizers. In other words, we have made the farmer a better farmer, a more practical farmer, and a better satisfied farmer; and, on the whole, the business has been profitable. Let us look at the matter of asparagus. It was formerly the custom in the asparagus district in Monmouth County for the farmers to purchase their fertilizing constituents in the form of New York horse manure, largely, paying about two dollars a ton for it, and applying twenty to thirty tons to the acre. Of course, they got very large yields, and they found that a profitable practice; but when they began to study the question they said, "Is there not some material that we can apply which will enable us to grow asparagus without manure?" They began to look into the question of the application of fertilizers for the growing of asparagus. Now, I know that four-fifths of the farmers who formerly used New York yard manure are using commercial fertilizers, and are making more money to-day than they ever made when they were applying yard manures, notwithstanding the fact that the price of asparagus is very much lower than it was a few years ago. One farmer came to the experiment station during the past year with a bunch of asparagus—a

farmer who has studied this question of the application of commercial fertilizers, and who is in the business not for fun but for business—and said: "That is a sample of my asparagus. I use nothing but commercial fertilizers. I contract for my entire crop at three dollars a dozen. I am clearing two hundred dollars an acre from it this year." He is doing that right along. He is not using a pound of yard manure. He is using commercial fertilizers intelligently and systematically, and is making big money on his investment. He does not use the commercial fertilizers on the "hit or miss" plan. He does not buy the "Lightning Crop Lifter." He buys nitrogen, phosphoric acid and potash. He does not know all that is necessary to be known about growing asparagus. He does not pretend to. But he knows enough to apply materials in such a way as to give him a large return upon his investment. And so I say we have made progress in the matter of the application of commercial fertilizers.

Take the matter of peach growing. New Jersey is a peach growing State; yet we make a good many failures. Success in peach growing is largely measured by the intelligence of the man who grows the peaches, by his particular intelligence concerning the application of the added necessary plant food. I know a farmer who during this past season netted, on an orchard of twenty acres, thirty-five hundred dollars. That was clean money, after every expense had been paid, including interest on his investment, and compensation for his own labor; and that was at the regular market rates. Thirty-five hundred dollars clean money on an orchard that was bearing its fourteenth crop! And yet the average peach grower says that a peach orchard is good for only three crops. Right alongside of that man orchards have come and orchards have gone. His orchard remains a profitable investment. The difference lies not in the soil, not in the climate, but in the method pursued by him in the application of his materials. I charge it up altogether to that. His varieties are not different from those of the others, but the difference lies in the application of his materials. He began to apply commercial fertilizers early in the life of the tree, and has continued to apply them. What does he apply? Largely bone and potash—ground bone and muriate of potash. Now that the trees are older, every spring he makes an application of two hundred pounds of nitrate of soda per acre. He has a reason for that. It results in dollars in his pocket, because that application has added to the potential fertility of that soil, has added to the actual food that those trees get from year to year. The result is that he has trees vigorous, strong, healthy, and he has fruit that is as fine as any that comes into market, and it always brings his price. It is a question of the intelligent use of material.

Let us look a moment at the sweet potato question, as illustrating the fact that there is something in this matter of applying materials. Again, it is a good deal like the asparagus question. A few years ago,

eighty-five thousand car loads of New York horse manure went down on the West Jersey Road into the sweet potato district. To-day, there are less than fifteen thousand car loads, as near as we can get at the figures. The result is more profit to the farmer than when he was using the larger amount of other material. This is because the farmer has learned that the commercial fertilizer is nothing more nor less than plant food, and that, if it is applied in the right way, and of the right kind, it will result in a largely increased crop. This method of the application of materials, of adjusting the materials to the kind of plants, and adjusting them to the conditions and character and object and growth of the plant, will result in a return which is profitable to the farmer; and it uplifts and helps all men because it uplifts and helps the man who is nearest to nature. I thank you, gentlemen, for your attention.

Mr. Appleton—We will now have the pleasure of listening to a few remarks from our old friend, Mr. Collingwood, of "The Rural New Yorker," in regard to practical farming and the use of fertilizers, and especially of barn-yard fertilizers.

Mr. H. W. Collingwood—Gentlemen, Farmers: There is just one point in regard to this fertilizer problem that I wish to refer to, and that is the soil itself. It seems to me that sometimes we pay too much attention to the purchase of fertilizers, and too little attention to the fact that the soil itself is capable of producing more by proper handling. I remember reading the story of a woman in a Nevada mining camp, a laundress, who spent her entire time toiling over the tub and bemoaning the fact that she was obliged to work so hard. It happened that in the ground beneath her, unknown to her, was a vein of silver. That vein of silver contained unlimited possibilities for luxury and enjoyment, but this poor woman continued toiling and bemoaning her poverty and inability to do better, because she did not know the vein was there. It seems to me that sometimes farmers are very much like that poor woman. They buy fertilizers, and work their farms to the best advantage, at considerable expense of thought and planning while, unknown to them, in that very soil, under their feet, lie possibilities of fertility and large crops.

One point I wish to make is with regard to the feeding of a crop to fertilize the ground. Most of us are familiar now with the idea of feeding a crop to sell or a crop to handle on the farm. Let us consider this idea of feeding a crop to fertilize the ground. In other words, let me call it "turning a crop out to pasture." When I was a young man at college, some years ago, four of us met one night in my little room, and got to discussing the money power, which was a favorite subject of discussion with us. I do not mean the money power in any large sense, but the financial backing that we had behind us, the money power that was pushing us through college. Each of us agreed to tell what it was that was back of him, pushing him through the college course. I remember I had nothing but my wits. They were not sharp enough to

cut a very large hole in the world, and they were not so dull but that it hurt my feelings when I went out as a book agent and could not sell a book. John, my neighbor on the right, went home every summer and put in ten acres of wheat. His father gave him the poorest acres on the farm, usually; his mother gave him the seed, and by the aid of his father's team he put in the ten acres of grain. The next year he went back and borrowed his father's reaper and team and harvested the wheat. Although his father always gave him the ten poorest acres on the farm, they still were paying his expenses through college. Jim, another boy, said that he was going through college on a pig's back. His father laid aside two pigs, and the increase of the pork from those two pigs was paying his expenses through college. The fourth boy said: "You fellows have told how you are pushing through college, but I am in clover. I read in the paper five years ago something about what clover would do for the soil, and I made a bargain with father by which I was to buy the seed and put it in, and he was to give me the increase of all crops after the four years' rotation was over, on account of that clover; and boys," he said, "I am rolling in wealth. What I want to learn at college is, how to make more clover on the farm." That set me to thinking about this idea of feeding a crop to produce manure, or to produce a fertilizer. My conviction is that the Southern cow pea is something that we could use to advantage. We have sometimes wondered if there was anything good in Southern agriculture. Most Northern men look upon it as a section of poor farming. It does not seem possible for any good practice to come out of Southern agriculture. Yet I believe that this Southern cow pea is destined to do more for the farmers of the North than anything that has appeared in agriculture since the discovery, by Liebig, that phosphates may be made soluble by the use of sulphuric acid. I believe by this we can brace up and build up our back fields. I do not know how it is with the New York farmers, but with us poor Jersey farmers you will find that we put most of our manure and fertilizer along the road, so that people who travel by and who see only the outside edge of the farms conclude that we are very good farmers; but if they go back two fields deep into the farm, they will find that beauty is but skin deep. The front of the farm is well tilled and cultivated, but back beyond the first field, those old "loafer fields," as I call them, have been growing up into weeds and bushes. I believe those poor fields, back on the farm, those neglected fields that many of us have abandoned, is the place where we can put the Southern cow pea and fertilize the entire farm. I believe that is perfectly possible. We can turn the Southern cow pea out to pasture, if I may put it in that way, and feed it on a little muriate of potash, and dissolved rock, and in that way secure a heavy growth of Southern peas for building up the fertility of the entire farm. I would turn those abandoned fields in the back of the farm into fertilizing factories in that way,

believing that it is entirely feasible, entirely practicable, and something which we farmers must come to in time, if we are going to make the whole farm bloom as it ought to. I look at it in this way, gentlemen; a man may succeed in art, a man may succed in literature, a man may be highly successful in finance in Wall Street, but, after all is said and done, I do not believe there is anything that will give more satisfaction and true pleasure than the fact that he has *saved a farm.* The fact that a man may take an abandoned piece of ground, a farm that some one else has run away from, a farm that somebody else has grown poor on and has had to abandon, a farm that in former years gave a good support to a family, but has now been deserted—the fact that he can restore that farm to fertility is a fact that is worth learning. Any man, be he rich or poor, I care not who he is, who can take such a farm as that and handle it economically, practically, intelligently, so that he may look back upon it years afterwards and say, "I saved that farm," will have a feeling of satisfaction that he cannot possibly attain in any other way. A man must feel a peculiar satisfaction who can say to himself, "I have saved a farm; I have given character, I have given strength to an abandoned, a rejected piece of land; I have done something for my country, I have done something for character." That is, perhaps, one of the noblest of ambitions that a man could have; and I believe our little friend, the Southern cow pea, with potash and rock, will enable any of us who will work and handle our farms properly to say, with gratification to ourselves, "I have saved a farm."

Mr. Appleton—With reference to what has been said in regard to the application of fertilizers to soils under certain conditions, I have been requested to ask Prof. Voorhees how we are to ascertain what are the needs of the soil?

Prof. Voorhees—There are two or three methods by which the needs may be ascertained. I think the chief one is the size of the crop which we are now obtaining. For example, suppose we are obtaining a crop of twenty-five or thirty bushels of corn per acre. We know that soil must lack something, because, in our localities, corn can be made to yield a hundred bushels per acre. Now, by a system of plot experiments, we can determine whether the immediate needs of that soil are phosphoric acid, potash or nitrogen, by applying each of them singly or in combination. In the long run you will find that on a soil which yields but that amount per acre all the constituents will be essential in order to bring it up to a maximum production. The simple way is to apply the materials in their single form upon individual plots, and note the results. If the increase is from phosphoric acid, and there is no increase from the application of nitrogen or potash, then phosphoric acid is what is needed, and so on. That is a temporary makeshift. The soil will need all the constituents, in the long run.

A vote of thanks to the gentlemen who had addressed the meeting, and to the steward, was then passed, after which the Farmers adjourned for the season.

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